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THESIS

THE USE OF SATELLITE IMAGERY FOR DOMESTIC LAW ENFORCEMENT

by

Raymond M. Schillinger

December 2013

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From an event management standpoint, and in concert with digital mapping applications, satellite imagery has proven its utility to support first responders and emergency services in a wide range of both natural and manmade disasters. Imagery data has also supplemented police activities in developing operational plans that can be prepared for short time, high risk responses at either public facilities or events.

This policy options analysis draws a side-by-side comparison of three approaches for the law enforcement community to readily acquire satellite imagery. One approach will make added use of the Civil Applications Committee, the second approach will explore the reactivation of the National Applications Office, and the third will investigate making greater use of commercially available sources. All three approaches have clear advantages and disadvantages, some more than others.

In the final analysis, the best policy option presented was making greater use of commercial providers. The relative ease to collect material and manage it with fewer obstacles, in comparison to the Civil Applications Committee and National Applications Office alternative, made it the better option.

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THE USE OF SATELLITE IMAGERY FOR DOMESTIC LAW ENFORCEMENT

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ABSTRACT

From an event management standpoint, and in concert with digital mapping applications, satellite imagery has proven its utility to support first responders and emergency services in a wide range of both natural and manmade disasters. Imagery data has also supplemented police activities in developing operational plans that can be prepared for short time, high risk responses at either public facilities or events.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

ACLU	American Civil Liberties Union
AIAA	American Institute of Aeronautics and Astronautics
ASC	Advanced Systems Center
AWACS	Airborne Warning and Control Systems
CAC	Civil Applications Committee
CIA	Central Intelligence Agency
CRS	Congressional Research Service
DHS	Department of Homeland Security
DNI	Director of National Intelligence
DoD	Department of Defense
EO	Executive Order
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAO	General Accounting Office
GEO	Geosynchronous Orbit
GFP	Global Fiducials Program
GIS	Geographic Information System
IC	Intelligence Community
IFOV	Instantaneous Field of View
IFTN	Imagery for the Nation
LE	Law Enforcement
LEO	Low Earth Orbit
KH	Key Hole
NAO	National Applications Office
NASA	National Aeronautics and Space Administration
NDSI	National Spatial Data Infrastructure
NGA	National Geospatial-Intelligence Agency
NOAA	National Oceanic and Atmospheric Administration
NRO	National Reconnaissance Office
NSGIC	National States Geographic Information Council

NSSE	National Special Security Event
PCA	Posse Comitatus Act
RFI	Request for Information
SME	Subject Matter Expert
UAS	Unmanned Aircraft System
UAV	Unmanned Arial Vehicle
USCS	United States Customs Service
USDA	United States of Agriculture
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The use of satellite reconnaissance for space borne observation is not a unique function to the mission of surveillance in a domestic applications context. As early as the 1960s national assets, to use a euphemism for military or intelligence community owned satellites, have been regularly used by an array of civilian agencies for scientific, mapping, environmental, disaster prediction and monitoring, and a host of other conventional non-military applications.

The law enforcement (LE) community is a proponent to any technology that enhances its mission of upholding the laws of the land, legal investigation, and evidentiary collection. With advancements in surveillance techniques, modern policing have been relegated to a science unto itself. What was traditionally conducted in a surveillance covey within close proximity to a potential perpetrator, may today involve a greater standoff that necessitate a greater array of collection tools and methods. However, with a new array of technology comes new policy on its justified use and application, as well as an accompanying set of legal questions.

Despite the warranted concerns, the utility of satellite imagery is apparent. In addition, further research is justified to investigate the feasibility of integrating and establishing advanced services, both government and commercial, for domestic law enforcement support and investigation. A key question to ask: in coordination with the military and intelligence community, as well as other government agencies, is there a mechanism that can provide LE with greater access to national asset products, or is there a suitable alternative in the form of commercial providers?

There exist, in present and past programs, multiple options that can be explored where lessons learned and mistakes encountered have occurred. This analysis investigated three policy options that could support LE operations: one, an existing federal program, the second is a former federal program, and the third is a nongovernment owned activity. Option one consists of supplementing the Civil Applications Committee to further support LE. Option two consists of reestablishing the

now defunct National Applications Office. Finally, option three consists of altogether eliminating government support, with the exception of disaster management, and having the duty of imagery collection through commercial providers managed at the lowest LE level.

The policy options choices were graded using the following criteria: 1 legislative support, 2 legal issues, 3 projected cost, and 4 ease to implement. Legislative support would gauge the likely confidence that enable the program to secure funding and sustain the program option. Legal issues identifies whether a suggested policy option solution would garner questionable or excessive legal scrutiny. Project cost anticipates the level of resources that will be necessary to enact the policy option. Ease to implement identifies the level of ease to enact the policy option. During the policy analysis assessment each of the four policy option grading criteria was assigned a rating of positive, neutral, or negative.

This thesis determined that the best policy option was option three, which was the least complex. Though there will always be an inherent distrust to any surveillance program, no matter its origin, in contrast to established government activities, LE would likely benefit far greater using commercial imagery providers. The relative ease to collect material with minimal obstacles is a clear benefit to its use. Though adherence to constitutional tenets is sacrosanct to any surveillance collection effort, being exempt from the Posse Comitatus Act and Executive Order 12333 would be another significant advantage for the use of commercial systems.

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This experience and adventure would not have been possible without the advice, help, and motivation from an array of people. Having been a student and now an alumnus of the Naval Postgraduate School is a true honor. The opportunity to attend the Center for Homeland Security and Defense is one of those pinnacles that will be hard to equal.

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I. INTRODUCTION

Hicks: Can you get a feature scan and pattern matching on him?

Van: No, he's smart, he never looks up.

Jones: Why does he have to look up?

Fiedler: The satellite is 155 miles above the Earth. It can only look straight down.

Jones: That's a bit limited, isn't it?

Van [Sarcastically]: well, maybe you should design a better one.

Jones: Maybe I will, idiot.

1998 film *Enemy of the State*

A. PROBLEM STATEMENT

The use of satellite reconnaissance for space-borne observation is not a unique function to the mission of surveillance in a domestic applications context. As early as the 1960s,[1] national assets, a euphemism for military or Intelligence Community (IC) owned satellites, have been regularly used by an array of civilian agencies for scientific, mapping, environmental, disaster prediction and monitoring, and a host of other conventional non-military applications.

Law enforcement (LE) is readily using satellite resources for a myriad of purposes. In order to ensure operational and emergency readiness, prepared activities have used this information to provide a better understanding of the communities that fall under its jurisdiction. Data for emergency planning can be drawn by using basic imagery services that are available free on the Internet or, if need be, acquired at cost through commercial or government services that can provide greater optical resolution and sensor requirements.

The LE community is a proponent of any technology that enhances its mission of upholding the laws of the land, legal investigation, and evidentiary collection. With

[1] United States General Accounting Office, *National Applications Office Certification Review* (Washington, DC: United States Government Accounting Office, 2008, 1, accessed May 14, 2013, http://www.gao.gov/assets/100/95855.pdf.

advancements in surveillance techniques, modern policing has been become to a science unto itself. What was traditionally conducted in a surveillance covey, within close proximity to a potential perpetrator, may today involve a greater standoff that necessitates a greater array of collection tools and methods. However, with a new array of technology comes new policy on its justified use, application, and an accompanying set of legal questions.

Technology is the easy part; nevertheless, for the intention of government enquiry, especially for LE, a series of legal considerations arise. Even against known criminals, the issue is wrought with privacy and civil liberty concerns from all levels of the law including: 1) constitutional rights, 2) statutory authorities and restrictions, and 3) executive branch authorities.

When properly employed LE surveillance, even satellite, is very legal; all the same, the constitutional law of the land and all its derivative statutes are sacrosanct to American society where most policy makers and the general public may wish to wane on the notion of "better to be safe than sorry."

From a disaster perspective, satellite imagery, in combination with geographic information systems (GIS) (or digital mapping applications), is a vital tool to develop first responder disaster and operational contingency plans. Without it, the ability to effectively fight hurricanes, wild fires, industrial accidents, or handle similar events, would be greatly hampered. In any short time, high risk LE action, specifically a standoff, hostage, or comparable scenario, the availability of this data to provide information, such as potential obstacles, points of ingress and egress, and urban specifics, is paramount in identifying details relating to an operating area and subsequent response.

Despite the warranted concerns, the utility of satellite imagery is apparent, and further research is justified to investigate the feasibility of integrating and establishing advanced services, both government and commercial, for domestic law enforcement support and investigation.

B. RESEARCH QUESTIONS

In coordination with the military and intelligence community, as well as other government agencies, is there a mechanism that can provide LE with greater access to national asset products, or a suitable alternative in the form of commercial providers? Can this activity be conducted while adhering to and addressing constitutional law and likely privacy concerns? Is there a mechanism or approach for assuaging the American public's to this type of surveillance; would a level of transparency work?

C. SIGNIFICANCE OF THE RESEARCH

An ample amount of open source imagery data through many vectors is available to peruse. From one standpoint, it is completely rational for an individual to query Google Earth occasionally. Most individuals today who have purchased real estate, whether it is a new home or a plot of property, have done at least a cursory check using some imagery service. The public use of this data is perfectly acceptable for this purpose. To see what a potential neighbor looks like from on high may be nefarious in nature, but it is still perfectly legal if used in the context of an open space environment.

From a macro standpoint, the citizenry welcomes the use of imagery satellites to characterize and manage natural or manmade emergencies; lives may depend on it. In addition, there appears to be no problem in their use when exploitation of the environment or community is involved. Society in general wants abuse identified and the culprits punished. There is often the perspective that the larger the wrongdoer, especially if it is big business, the larger the punishment that should be handed. At this level, where illegal logging, uncontrolled oil spills, or factory disasters, can be observed, satellite systems are well accepted by the American populace as evidentiary tools for the courts[2]. However, there is often a stark contrast when these same tools are used at the micro level towards individuals, and maybe rightly so.

[2] Satellite imagery is being used for litigation resulting from the 2010 Deepwater Horizon Oil Spill.

D. CHAPTER BREAKDOWN

This thesis examines the feasibility of using national assets, or alternative satellite systems, for the use of domestic law enforcement. Chapter I identifies a simplified background on the use of satellite imagery that poses a basic examination of salient details necessary for inclusion, in addition to the principle focus, and provides a justification for its further exploration and study. Chapter II explores the literature on the topic on satellite imagery along with the sub topics related to applications and systems technology, existing and former programs, and the law itself. Key points will include their direct source, whether from government, industry, or academia, and elements of the literature search that required further inquiry. Chapter III provides a discussion and background on satellite imagery and related subjects. Basic systems technology, applications, and capability are presented, followed up with a history of civilian programs. Chapter IV discusses key laws relating to surveillance and their impact. Chapter V provides the methodology and analysis of policy options studied. In addition to showing current, former, and potential future program alternatives relating to satellite imagery support, a list of key considerations are presented along with an examination of pros and cons. Chapter VI discusses the overall conclusions and lessons to be learned.

II. LITERATURE REVIEW

The literature review provided a roadmap and approach to breaking down the subject of the domestic LE use of reconnaissance satellites. A significant amount of technical data regarding systems capabilities was readily available, principally from government, academia, professional organizations, and industry groups. Though applicable unclassified government sources provided an important element to the literary search, often the information was geared too much towards a military applications as oppose to a more civilian employment.

Several categories of literature were explored that described applications and systems technology, existing and former programs, and the law. Academia provided a significant amount of information on systems technology. The information was significantly greater than military sources that tended to be sparse due to classification issues, and it was better than industry sources because they had the tendency to be biased towards their specific products.

A major source for credible information, as well as controversial information, that follows any type of surveillance activity included the General Accounting Office (GAO), American Civil Liberties Union (ACLU), and the Congressional Research Service (CRS). With the introduction of unmanned aerial vehicles (UAV) and unmanned aircraft systems (UAS) incorporated into LE activities, questions are continuously being raised regarding the efficacy, legitimacy, and legality of aerial drone operations. This tied in very well with the principle issue of satellite surveillance. Though the technology of national assets and surveillance drones are significantly different, the applications and necessary legal tenets are similar.

A. APPLICATIONS AND SYSTEM TECHNOLOGY

There are several publications on systems application and technologies that are accessible from multiple credible sources: key activities included academia, the American Institute for Aeronautics and Astronautics (AIAA), the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric

Administration (NOAA), the U.S. Air Force Space Command, and the FAA Office of Commercial Space Operations. If applications and systems capabilities could not be studied because of either military sensitivity or industry propriety, several inferences could be made with regards basic technology from unclassified sources.

Imagery capability is an extremely sensitive topic to many government agencies, and rightly so. However, with the exception of streaming data, private industry can provide imagery and sensor data for multiple uses and customers. The technologies provided are comparable to government agencies and easily integrated into any civilian application.[3] The shift from government to commercial is obvious within systems design and development. It is apparent that though the U.S. government may own systems and manage operations, industry is leading development, systems capability, and launch services.

The commercial space industry, both satellite manufacturing and launch services, has been growing since the mid-1990s. Literature since the inception of Sputnik to today's modern space ventures portray a tilting of the past government-only club to an activity run almost exclusively by private corporations. To put the government to industry transition into perspective, though the U.S. government is a key owner of satellite systems, they are only a 10 percent customer-base on commercial systems.[4]

One item identified early in the search presented that, despite an overall reduction in government launches in contrast to past years, an ever increasing prevalence of civilian ownership in space is apparent. Case in point, the Federal Aviation Office of Commercial Space Transportation projections are forecasting an average of 29.1 commercial space launches per year worldwide from 2012 to 2021.[5]

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[3] Robert A. Weber and Kevin M. O'Connell *Alternative Futures: United States Commercial Satellite Imagery in 2020* (Washington, DC: Department of Commerce andNational Oceanic and Atmospheric Administration, 2011).

[4] United States General Accounting Office [GAO], *Critical Infrastucture Protection Commercial Satellite Security Should Be Fully Addressed* (GAO-02-781) (United States General Accounting Office: Washington, DC: 2002), 1–3.

[5] Federal Aviation Administration Commercial Space Transportation and Commercial Space Transportation Advisory Committee, *2012 Commercial Space Transportation Forecast* (Washington, DC: Federal Aviation Administration, 2012), 1.

B. FORMER AND EXISTING PROGRAMS

The domestic use of national assets is almost as old as their initial deployment during the Cold War. From a historical perspective a prime literature source was derived from the National Security Archive, managed by George Washington University.[6] The archive maintained several documents not only on the military application, but the domestic application of national assets as well.

Declassified sources going as far back as 1967, detailed as the "Problems Relating to the Feasibility of Use of KH Photography by Civilian Agencies,"[7] proposed making highly classified satellite imagery available to civilian agencies for mapping and science based programs. Subsequent archival documentation would further describe the use of national asset imagery data for a host of non-intelligence civilian agencies. Older documents show strictly mission oriented details, such as minimal discussion presents the law as it relates to Posse Comitatus, constitutional, privacy, or similar statutes that are prevalent issues today. Literature from more recent satellite imagery providers included information from the U.S. Geological Survey (USGS), Civil Applications Committee (CAC), and the former Department of Homeland Security, National Applications Office (NAO).

The CAC was developed to provide a conduit through which civilian agencies can coordinate the use national asset for non-military or intelligence tasking. A typical CAC mission would likely be scientific in nature to either support the civilian scientific community or government policy makers. Similar to historical documentation, a significant amount of CAC source data is available through the National Security Archive. Current literature, specifically as it relates to its mission, can be viewed through USGS sources. However, though the activity provides a significant amount of information with regards to scientific, geological, and mapping tasking, with the

[6] The National Security Archive relating to U.S. domestic satellite reconnaissance can be viewed on http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/index.htm.

[7] National Security Archive, "U.S. Reconnaissance Satellites: Domestic Targets," January 11, 1967, George Washington University, accessed March 23, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/01.pdf. Copy of memorandum "Problems Relating to the Feasibility of Use of KH Photography by Civilian Agencies," 1967.

exception to disaster support, minimal information was available on specific LE support. An offshoot to the CAC that was specifically designed to support the LE community was the NAO. In 2005, the Office of the Director of National Intelligence (DNI) and the USGS commissioned a blue-ribbon panel[8] to identify how the CAC could better facilitate its satellite missions and data request coordination. As a result of the commission's recommendations the DHS NAO was established in 2007.

Unfortunately most, if not all, the literature found on the NAO was controversial from a civil liberties and privacy concern standpoint. Being active for only two years before it was shut down, minimal information could be found on the actual utility of the program while it was active.[9]

C. THE LAW

Any space role, no matter the intension, whether on government or commercial satellite platforms, for the purpose of safety and security, etc., is going to immediately present a potentially unwarranted domestic space surveillance motive to the citizenry; the scrutiny is justified. When investigating the legitimacy of any type of surveillance, including satellite, the Fourth Amendment, which protects "persons, houses, papers, and effects against unreasonable search and seizures,"[10] is at the epicenter. The use of advanced surveillance methods presents multiple questions; for example, does it in fact constitute an active "search" under the Fourth Amendment?[11] Two key cases on the use on advanced surveillance include Katz v. United States[12] and Kyllo v. United States;[13] both cases will be presented in greater detail in Chapter IV.

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[8] Booz Allen Hamilton, *Civil Applications Committee Blue Ribbon Study: Independent Study Group Final Report*, 2005, Federation of American Scientists, accessed May 8, 2013, https://www.fas.org/irp/eprint/cac-report.pdf.

[9] Department of Homeland Security, "Secretary Napolitano Announces Decision to End National Applications Office," news release, June 23, 2009, accessed September 20, 2012, https://www.dhs.gov/news/2009/06/23/secretary-napolitano-announces-decision-end-national-applications-office-program.

[10] U.S. Constitution, Amendment IV.

[11] Brody Korody, *Satellite Surveillance within U.S. Borders* (Ohio State University, OH: Moritz College of Law, 2005), 1641.

[12] Katz v. United States, 389 U.S 347, (1967).

[13] Kyllo v. United States, 533 U.S. 27, (2001).

Other key legal tenets where literature is readily available from multiple sources include the Posse Comitatus Act (PCA) and Executive Order (EO) 12333. The PCA was established, with few exceptions, to prohibit the American military and agencies from engaging in domestic law enforcement.[14] Executive Order 12333—United States Intelligence Activities establish laws with regards to U.S. intelligence activities and their use both domestically and abroad.

From a legal perspective, plenty of literature is available from multiple sources. An item that will be beneficial is taking the lessons learned from UAS and UAV surveillance and applying it to satellite systems.

D. CONCLUSION

The technical and operational aspects of imagery satellites are readily available; information from sensitive military programs could be easily inferred through complimentary commercial systems. An impediment to LE getting direct access to national asset data, for any reason outside of monitoring and managing natural and manmade disasters, is the justified fear of establishing an even greater toehold in advanced domestic surveillance and the perception of an overextension of police powers. Though it was the author's intent to draw a greater understanding of satellite systems and operations unto themselves, and leave out the role of law until further study was conducted, it became necessary to include it.

In summary sub-category strengths and weaknesses were clearly identified:

1. Science can be investigated easily, there were multiple sources and many indirect approaches to getting good information,
2. A major weakness in the existing literature involved minimal specific information regarding the ultimate utility and success of civilian government agencies tasked with coordinating satellite operation; this is a topic that will require further investigation,
3. Lessons learned from UAV and UAS programs can be readily applied to this research, and
4. There is plenty of literature with regards to the law and surveillance.

[14] Korody, *Satellite Surveillance*, 1636.

The following chapter will provide an insight into many of the relevant aspects of satellite imagery and discuss in greater detail early programs, satellite technology and applications, and government programs designed to support LE activities.

III. BACKGROUND AND DISCUSSION

> *Tonight we know how many missiles the enemy has, and it turned out our guesses were way off. We were doing things we didn't need to do. We were building things we didn't need to build. We were harboring fears we didn't need to harbor.*
>
> President Johnson, 1967[15]

A. INTRODUCTION

Many deductions are made at the reverse engineering level to determine what National Reconnaissance Office (NRO) systems, or national assets, past KH-9 can actually provide at the resolution level. Though often an interesting exercise, lacking vital data or imagery would make it a guessing game before a new generation of systems are deployed and existing systems are declassified. In comparison to NRO equipment, often the question is asked: what can commercially available systems provide? Just looking at Google and its use of GeoEye based products on Google Earth applications,[16] using simple reverse engineering on available data sheets indicates that a GeoEye imagery satellite has an approximate resolution of half a meter. A lot can be seen using this resolution; obliviously rural and urban structure will be somewhat easy to identify…vehicles will be easily discerned, albeit colors will be difficult to identify and the smaller the vehicle the harder it will be to identify. One thing that commercial satellite for consumer use cannot do, at least for now, is identify an individual or small objects, look at a license plate, track individuals with any level of fidelity, look for the cat, or take a picture in real time.

This section breakdowns information on the history, technology, and applications of both government and commercially available imagery. Though by no means complete,

[15] Smithsonian Air and Space Museum, "Satellite Reconnaissance: Secret Eyes in Space," 2002, accessed June 15, 2013, http://airandspace.si.edu/exhibitions/space-race/online/sec400/sec400.htm.

[16] Google Earth, "Google Earth™ Integration Tools," DigitalGlobe GeoFuse, 2013, accessed August 31, 2013, http://geofuse.geoeye.com/landing/google-earth/.

the information provided will provide a basic notion of imagery application and at the very least provide a starting point for further enquiry.

B. SATELLITE IMAGERY IN ITS PRIMACY

1. Early and Current Military Satellite Programs

With the increased risk of manned flight over Cold War Russian territory getting greater, despite the technological leaps in high attitude surveillance aircraft, another option was necessary to fill the US aerial reconnaissance gap. The experimental concept of conducting satellite imagery started immediately after the Russian launch of Sputnik I, with the development of Discoverer.

Program Discoverer commenced in 1956 and later transferred to the Defense Advanced Research Project Agency as a system that collected satellite imagery from space based platforms. After a historic flight, where on August 11, 1960, Discoverer 14 successfully returned a film canister from space, the program was renamed Corona and established a satellite reconnaissance program that would soon introduce the KH[17] satellite series that continues operations today in support of the NRO.

The specialized film that Corona carried was developed by Eastman Kodak, utilizing a 70mm film strip, and with a 61centimeter focal length camera, it produced an initial resolution of 170 lines per millimeter.[18] Recoverable drums started with 2,400 meters of film in the KH-1 and eventually had a capacity of 4,900 meters by the KH-5.[19] Using Itec Corporation cameras, imagery resolution started from a somewhat discernible eight meters to eventually two meters when the last collections were conducted and eventually declassified in 1995 up to KH-6 Lanyard imagery.[20] Though extremely low in resolution compared to current systems, the pictures still provided early analyst a means to determine an area order of battle. Specific weapons system and

[17] Keyhole (KH) denoted satellite photographic intelligence collection missions.

[18] National Reconnaissance Office, "Corona Fact Sheet," National Reconnaissance Office, accessed April 27, 2013, http://www.nro.gov/history/csnr/corona/factsheet.html.

[19] Sidney D. Drell, "Physics and U.S. National Security," *Reviews of Modern Physics* 71, no. 2 (1999): 462.

[20] National Reconnaissance Office, "Corona Fact Sheet."

deployment could be easily determined and provided military planners with a vital intelligence tool.

Figure 1 depicts a canister recovery of KH film-based systems until KH-11 digitized systems were deployed.

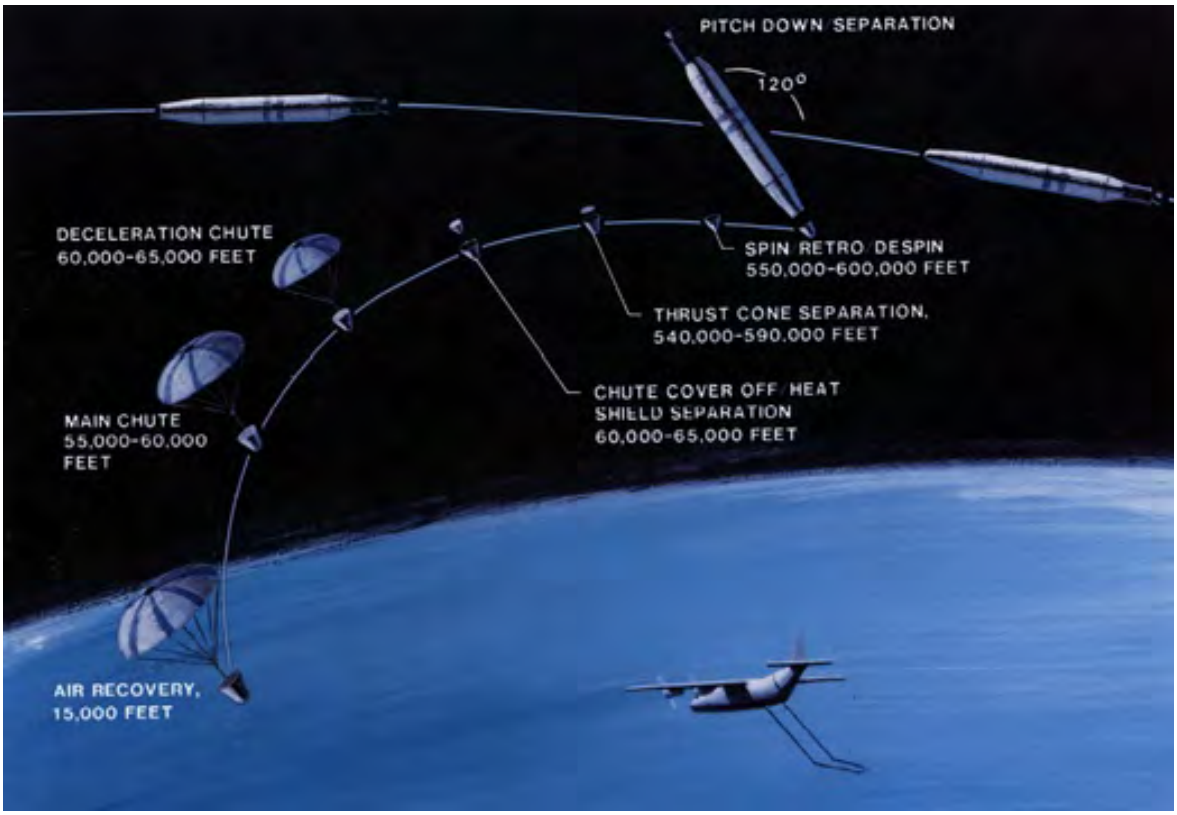

Figure 1. KH1 to KH-9 Film Recovery[21]

Other NRO systems followed using the KH-5 to KH-12 Lacrosse Onyx. With the development of systems came advanced technology, expanded mission capabilities, and an improved array of intelligence data for military planners. As follow-on to the KH-4 series, other systems included:

1. KH-5 Argon: Program Argon, which had 13 launches and only six successful missions, started flights from 1961 to 1964 and maintained a

[21] National Reconnaissance Office, "CORONA Launch and Recovery," National Reconnaissance Office, accessed August 15 2013, http://www.nro.gov/history/csnr/corona/sysinfo.html.

significant lower resolution in comparison to previous systems, up to two meter resolution for KH-4 flights as oppose to 140 meters for KH-5.[22] The key reason for this significant disparity and somewhat reduction in capability was its principle mission of polar region mapping development that inherently required less resolution as oppose to traditional satellite reconnaissance on military targets.[23]

2. KH-6 Lanyard: Program Lanyard, which had three launches with only one successful mission, literally finishing the same year it began operations in 1963, was an initial attempt to combine a tilting camera array, both forward and aft, to provide a stereo photography capability with a design resolution of two meters.[24] Though an operational failure, Lanyard provided a significant technical stepping stone for future systems and operational advances.

3. KH-7 Gambit 1: Program Gambit 1, which had 38 launches with 28 successful missions conducted operations from 1963 to 1967, was considered one of the first successful high resolution reconnaissance satellites that broke the two to three foot high resolution barrier.[25]

4. KH-8 Gambit 3: Program Gambit 3, which had 54 launches with 50 successful missions conducted operations from 1966 to 1984, had many camera modifications.[26] This includes a stabilized camera platform that

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[22] Robert Perry, *A History of Satellite Reconnaissance* (BYE-17017-74) (Washington, DC: National Reconnaissance Office, 1974), 100–102.

[23] Robert Brindschadler and Wendy Seider, *Declassified Intelligence Satellite Photography (DISP) Coverage of Antartica* *NASA/TM-1998-206879) (Greenbelt, MD: National Aeonautics and Space Administration, 1998).

[24] Perry, *A History of Satellite Reconnaissance.*

[25] National Museum of the U.S. Air Force, "GAMBIT 1: KH-7 Reconnaissance Satellite," last modified, January 20, 2012, accessed August 28, 2013, http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=19106.

[26] Ibid.

allowed for clearer picture and a mechanism that economized film use resulting in the ability to conduct more collection missions.[27]

5. KH-9 Hexagon: Program Hexagon, which had 20 launches with 19 successful missions conducted operations from 1971 to 1986, along with most features of previous equipment, it maintained a large panoramic camera array that could image a large swath of landmass approximately 370 miles in length.[28] Hexagon's principle mission was to collect large area imagery in addition to spot imagery; over 870 million square miles of area was collected during this program.[29]
6. KH-10 Dorian: Program Dorian was a manned orbiting laboratory the principle purpose of which was to conduct satellite reconnaissance from a manned platform. After one exploratory launch the program was cancelled.[30]
7. KH-11 Kennan: Program Kennan, launched in December 1976, was the first satellite reconnaissance system to utilize electro optical digital imagery with a real-time capability[31] developed with multiple variants. The oldest of these was operating for 17 years, and the last vehicle was launched on August 28, 2013.[32]

With the last launch of the KH-11 Kennan series, the NRO has been replacing systems with classified programs, including the KH-12 Improved Crystal and Lacrosse Onyx, satellites that will have significantly more capability than previous systems. A key

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[27] National Reconnaissance Office, "Gambit 3 Fact Sheet," September 2011, National Reconnaissance Office, accessed September 20, 2013, http://www.nro.gov/history/csnr/gambhex/Docs/GAM_3_Fact_sheet.pdf.

[28] National Reconnaissance Office, "Hexagon Fact Sheet," September 2011, National Reconnaissance Office, accessed September, 2013, http://www.nro.gov/history/csnr/gambhex/Docs/Hex_fact_sheet.pdf.

[29] Ibid.

[30] Dick Stevens and Roger Launius, *Societal Impact of Space* (Washington, DC: National Auronautical Space Administration, 2007), 293–294.

[31] National Reconnaissance Office, "50 Years of Vigilance from Above," 2011, National Reconnaissance Office, accessed September 1, 2013, http://www.nro.gov/about/50thAnniv/50th-Flyer.pdf.

[32] William Graham, "ULA Delta IV-H launches with NROL-65," August 28, 2013, accessed August 30, 2013, http://www.nasaspaceflight.com/2013/08/ula-delta-iv-h-launch-nrol-65/.

element in systems capability, in addition to digital data link, is the trend towards platforms that have a deployment cycle of over 10 years.[33] Another trend that is occurring are missions being carried out primarily by government run systems but supplemented by commercial satellite owners and operators.

2. U.S. Civilian and Commercial Satellite Programs

According to the Satellite Industry Association 2012 State of the Industry Report, the increasing service demand for navigation, communication, and television satellite based products has created a business producing annual revenues in excess of $200-billion,[34] and has resulted in a multi-trillion dollar industry that touches every person on earth. One item that was identified early presented an ever increasing civilian ownership of space, which the Federal Aviation Office of Commercial Space Transportation projections are forecasting an average of 29.1 commercial space launches per year worldwide from 2012 to 2021.[35] With over 60 countries having a role in satellite ownership and operations,[36] it is the opinion of this author that this assessment is low.

Launched in July 1972, Landsat, whose mission was geared towards earth observation imagery, is the longest running civilian satellite activity to date, and the program continues to operate using seven satellite variants. Started as a joint effort between NASA, whose role was to develop the space package and sensors, launch the system, and validate its performance, and USGS, who afterwards would assume custody of the equipment and would manage missions, collect data, analyze it, archive it, and distribute to respective customers.[37] Landsat's principle purpose is land and environmental scientific study. Using an array of spectral band sensors, the system provides valuable information to the earth science communities to judge the relative

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[33] Ibid.

[34] Satellite Industry Association, *2012 SIA State of the Satellite Industry Report*, 2012, , accessed 27 October, 2012, http://www.sia.org/about/.

[35] Federal Aviation Administration Commercial Space Transportation and Commercial Space Transportation Advisory Committee, *2012 Commercial Space Transportation Forecast*, 1.

[36] Space Security Index, *Space Security 2011* (Kitchener, Ontario: Pandora Press, 2011), 17.

[37] United States Geological Survey, "Landsat—A Global Land-Imaging Mission," May 2013, accessed August 3, 2013, http://pubs.usgs.gov/fs/2012/3072/fs2012-3072.pdf.

health of a specific landmass relating to global change, climatology, forestry, agriculture and farming, and a host of other earth environment topics.

There have been a number of iterations of Landsats with evolving capabilities. To draw a comparison between Landsat 1 and Landsat 8 with regards to sensor capabilities, Landsat 1, which operated from July 23 to August 5, 1972, only collected 1692 images at 80 meters resolution.[38] Using two scientific packages, seven sensors collected data in seven spectral bands.[39] Landsat 8, the newest system deployed since February 11, 2013, will likely collect for years if not into the next decade.[40] In addition, it will use a scientific package with 11 sensors collecting in 11 spectral bands.[41]

Figure 2 shows almost 20 years of Landsat collected water characterization; dark blue indicate deep seas while lighter blue indicates shallower seas.[42] The loss of water over this time span is attributed to the diversion of the River Jordan, the sea's principle water source.[43]

[38] United States Geological Survey, "USGS Science for a Changing World," *Landsat 1 History.* January 16, 2013, accessed August 29, 2013, http://landsat.usgs.gov/about_landsat1.php.

[39] Ibid.

[40] Ibid.

[41] Ibid.

[42] EarthSky, "View from Space: Dead Sea from 1972 to 2011" [image], EarthSky, April 16, 2012, accessed October 4, 2013, http://earthsky.org/earth/view-from-space-dead-sea-from-1972-to-2011.

[43] Rob Waugh,"Forty Years from 440 Miles Up: Nasa's Landsat Releases Top 10 of Unforgettable Images in the Earth's Modern History," *Daily Mail*, July 25, 2012, accessed October 4, 2013http://www.dailymail.co.uk/sciencetech/article-2178728/Four-decades-looking-Nasas-Landsat-team-releases-unforgettable-moments-world-history--seen-440-miles-up.html.

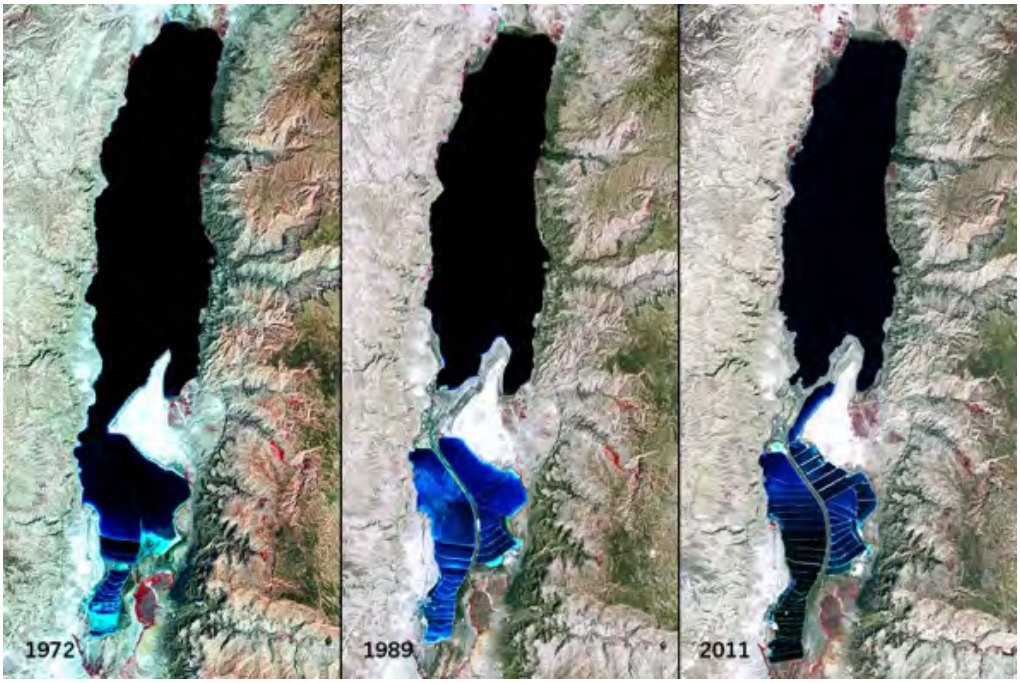

Figure 2. Landsat Comparisons of the Dead Sea[44]

In comparison to limited-access military programs, Landsat made satellite data available to the public for the first time. As a precursor of civilian access to improved imagery, with both the French (Centre National d'Etudes Spatiales—the French space agency) and Russian (Sovinformsputnik—a Russian satellite imagery provider) satellite industry making high resolution imagery, at three meters or less, available to the market place, the U.S. lifted restrictions on the sale of U.S. commercial imagery within the U.S.[45] In 1994, the Clinton administration initiated policy that would allow commercial entities to participate in the burgeoning new market; ironically one of the newest customers became the IC itself.[46] Having merged with several commercial satellite operators, DigitalGlobe would emerge as one of the largest purely commercial imaging satellites providers worldwide; its capabilities include:

[44] EarthSky, "View from Space: Dead Sea from 1972 to 2011."

[45] Korody, *Satellite Surveillance within U.S. Borders*, 1635.

[46] Richard C. Olsen, *Remote Sensing from Air and Space* (Bellingham, WA: SPIE Press, 2000), 24–29.

1. Ikonos: Launched in September 24, 1999, Ikonos was the first commercial system that could collect black and white panchromatic imagery with a resolution of .8 meters and color at 3.2 meters.[47] Area collection consists of an operational swath width of 11.3 kilometers that results in a daily of collection of approximately 240,000 landmass square kilometers.[48] The mission life span is expected to exceed 12 years.[49]
2. Quickbird: Launched in October 18, 2001, Quickbird has a collection resolution capability of 64 centimeters. Area collection consists of an operational swath width of 18.8 kilometers that results in a daily collection of approximately 200,000 landmass square kilometers at 450 kilometer altitude and approximately 100,000 landmass square kilometers at 300 kilometer altitude.[50] The mission lifespan is anticipated to continue to mid-2014.[51]
3. Worldview-1: Launched in September 18, 2007, Worldview-1 has a collection resolution capability of half a meter. Area collection consists of an operational swath width of 17.7 kilometers resulting in a daily collection of approximately 1.3 million landmass square kilometers.[52] The mission lifespan is anticipated to be approximately 10 to 12 years.[53]
4. GeoEye-1: Launched in September 6, 2008, GeoEye-1 can collect black and white panchromatic imagery with a resolution of 41 centimeters and color at 1.65 meters.[54] Area collection consists of an operational swath

[47] DigitalGlobe, "IKONOS Data Sheet," June 2013, accessed July 19, 2013, http://www.digitalglobe.com/sites/default/files/DG_IKONOS_DS.pdf.

[48] Ibid.

[49] Ibid.

[50] DigitalGlobe, "Quickbird Data Sheet," July 2013, accessed July 19, 2013, http://www.digitalglobe.com/downloads/QuickBird-DS-QB-Web.pdf.

[51] Ibid.

[52] DigitalGlobe, "WorldView 1 Data Sheet," January, 2013, accessed July 19, 2013, http://www.digitalglobe.com/downloads/WorldView1-DS-WV1-Web.pdf.

[53] Ibid.

[54] DigitalGlobe, "GeoEye-1 Data Sheet," June 2013, accessed July 20, 2013, http://www.digitalglobe.com/sites/default/files/DG_GeoEye1_DS.pdf.

width of 15.2 kilometers results in a daily of collection of approximately 350,000 landmass square kilometers.[55] The mission life span is expected to exceed 10 years.[56]

5. WorldView-2: Launched in October 8, 2009, WorldView-2 can collect black and white panchromatic imagery with a resolution of 46 centimeters and color at 1.85 meters.[57] Area collection consists of an operational swath width of 16.4 kilometers resulting in a daily of collection of approximately 1,000,000 landmass square kilometers.[58] The mission life span is expected to exceed 10 to 12 years.[59]

Figure 3 shows one of the first foreign reconnaissance collections on a former Soviet Union airfield using Corona in 1960 and the same collection 50 years later using a commercial GeoEye system.

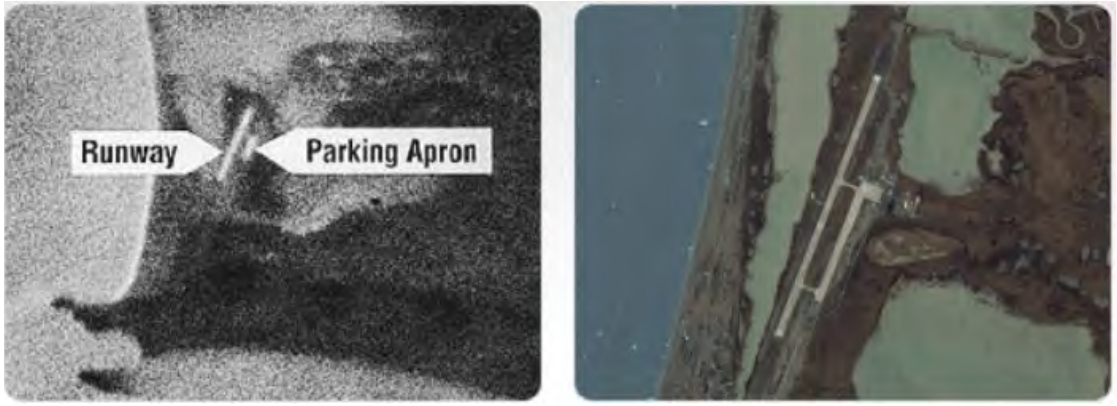

Figure 3. Mys Shmidta Air Field Russia, 1960 Corona (L) and 2010 GeoEye (R)[60]

[55] Ibid.

[56] Ibid.

[57] DigitalGlobe, "WorldView-2 Data Sheet," June 2013, accessed July 19, 2013, http://www.digitalglobe.com/downloads/WorldView2-DS-WV2-Web.pdf.

[58] Ibid.

[59] Ibid.

[60] National Security Archive, "The New Geospatial Tools: Global Transparency Enhancing Safeguards Verification," October 27, 2010, accessed October 2, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB439/docs/Underground-Pabian.pdf.

The commercial space industry, both satellite manufacturing and launch services, has been growing since the mid-1990s. Events since the inception of Sputnik to today's modern space ventures portray a tilting of a government-only club to an activity run almost exclusively by private corporations. To put the government to industry transition into perspective, though the U.S. government is a key owner of satellite systems, it is also a 10 percent customer-base on commercial systems.[61] Civilian and commercial based satellite products are vital to all sectors: military, intelligence, civilian government, and, ultimately, the home consumer. Though the exact capability of NRO-based national assets is unknown until the next declassification cycle, the typical web browser is routinely gaining access to high resolution data that would have been unheard of a decade ago.

C. SATELLITE TECHNOLOGY

Thousands of details are taken into consideration during an imagery collection effort, all of which could fill volumes of technical publications. For the common nonscientific or nonmilitary user, several of these very specific details are not necessary to exploit satellite imagery. To simplify specifics for the day-to-day user, short of the actual analysis itself, minimal key parameters need to be considered when either collecting or querying imagery.

Though the military community will use a multitude of technical specifics to analyze an area of operation, enemy order of battle, site environmentals, and an array of other mission based tasks, typical users realistically do not have the luxury of an analysis shop that is capable of consolidating hundreds of details, often in real time, in a quick turnaround product. What is necessary is to have access to imagery itself and a time line of collection. Taking these two key items into consideration, the ability to recognize an image and associate it with a time is the crux of its application.

The starting point of the basics of imagery collection is to have an understanding of remote sensing as a whole. Remote sensing defined is the measurement of object properties on the earth's surface, without being in direct contact, where the data is

[61] GAO, *Critical Infrastucture Protection Commercial Satellite Security*, 1–3.

collected from an airborne vehicle.[62] The interaction of the components of remote sensing involves the interaction between the sensor array and intended target, and a host of steps in between until a final data package is delivered to the consumer. As shown in Figure 4, this process includes seven steps:[63]

1. a natural or manmade source energy to illuminate the specific target of interest
2. atmospheric interaction that the source energy will transit through to illuminate the target
3. source energy interaction with the object where the target itself is characterized and data is returned, through the same atmosphere it entered, to the sensor collection array
4. the sensor array further processes the data for transmission
5. the sensor transmits the data, the ground based activity collects it and further processes it
6. data is analyzed and distributed to the final end user
7. and the final product is used for its specific application

[62] Robert Schowengerdt, *Remote Sensing: Models and Methods for Image Processing* (Burlington, MA: Academic Press, 2006), 2–3.

[63] Natural Resources Canada, "What is Remote Sensing?" last modified January 1, 2008, accessed September 1, 2013, http://www.nrcan.gc.ca/earth-sciences/geography-boundary/remote-sensing/fundamentals/1924.

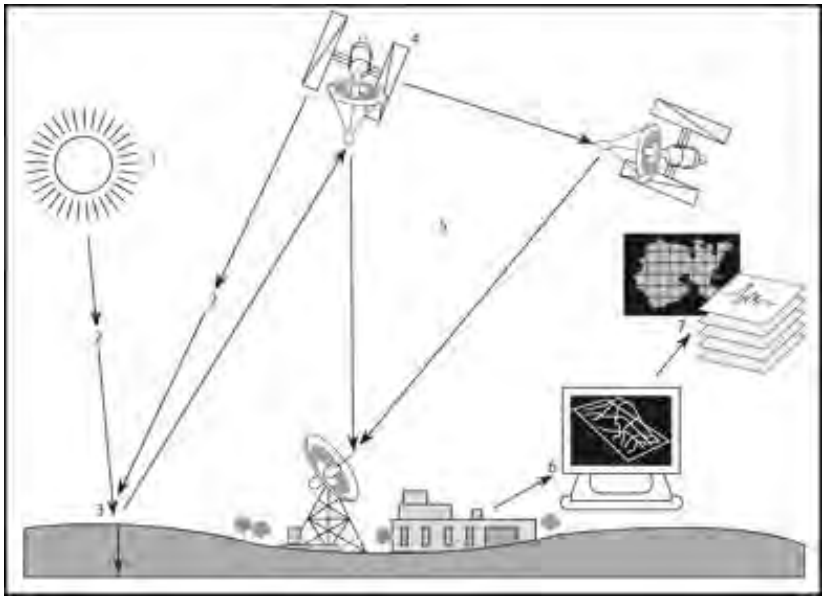

Figure 4. Steps of Remote Sensing[64]

One parameter that is discussed with regard to satellite application is resolution; this is the one term that is important for all end users to somewhat understand. Two elements of resolution include either spacial, which relates to the image itself, and temporal, which relates to time. Applying the two together combines the photographic detail of the image in relationship to collection time.

Starting with spacial resolution, when using a satellite camera array, the amount of area coverage depends on the system's instantaneous field of view (IFOV). Similar to taking ground based pictures, a wide IFOV will present a picture with a significant amount of area. In contrast a picture with a narrow IFOV, or close up, will present a picture with a smaller amount of area. The size of this footprint varies in relation to the altitude, or operating region, of the satellite system.

As depicted in Figure 5, a system operating within low earth orbit (LEO), for example approximately 1000 kilometers altitude above the earth's surface, will provide a

[64] Ibid.

15 percent earth surface observation area. In contrast, a similar system in order to cover approximately a 43 percent swath of landmass may require an operating altitude within high earth or geosynchronous orbit (GEO) at approximately 36,000 kilometers.[65] That is not to say the lower altitude system can widen its IFOV or the higher can narrow its IFOV, but depending on the platform, this may occur with a loss spacial resolution.

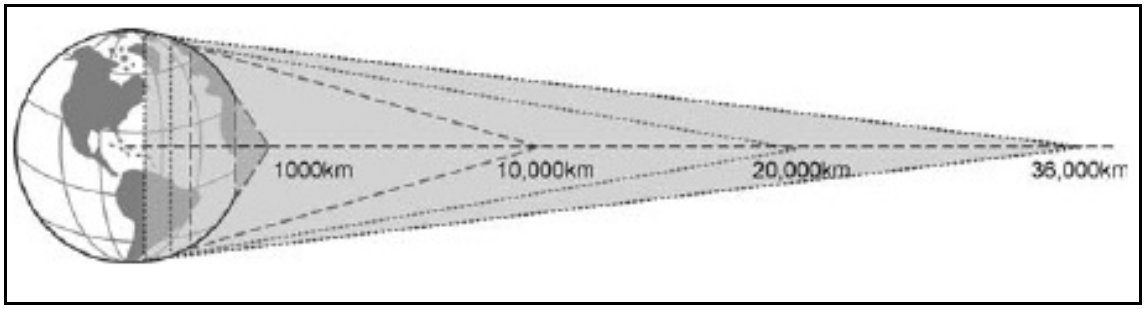

Figure 5. Earth Coverage[66]

Using a football field as a target IFOV, Figure 6 presents a depiction of new commercial systems with regards to ground sampling, in comparison to older system capability.[67]

[65] Anil Kumar Maini, *Satellite Technology: Principles and Applications* (Hoboken, NJ: Wiley, 2010), 120.

[66] Ibid.

[67] National Aeronautics and Space Administration, *Landsat 7 Science Data Users Handbook*, March 11, 2011, accessed August 28, 2013, http://landsathandbook.gsfc.nasa.gov/pdfs/Landsat7_Handbook.pdf.

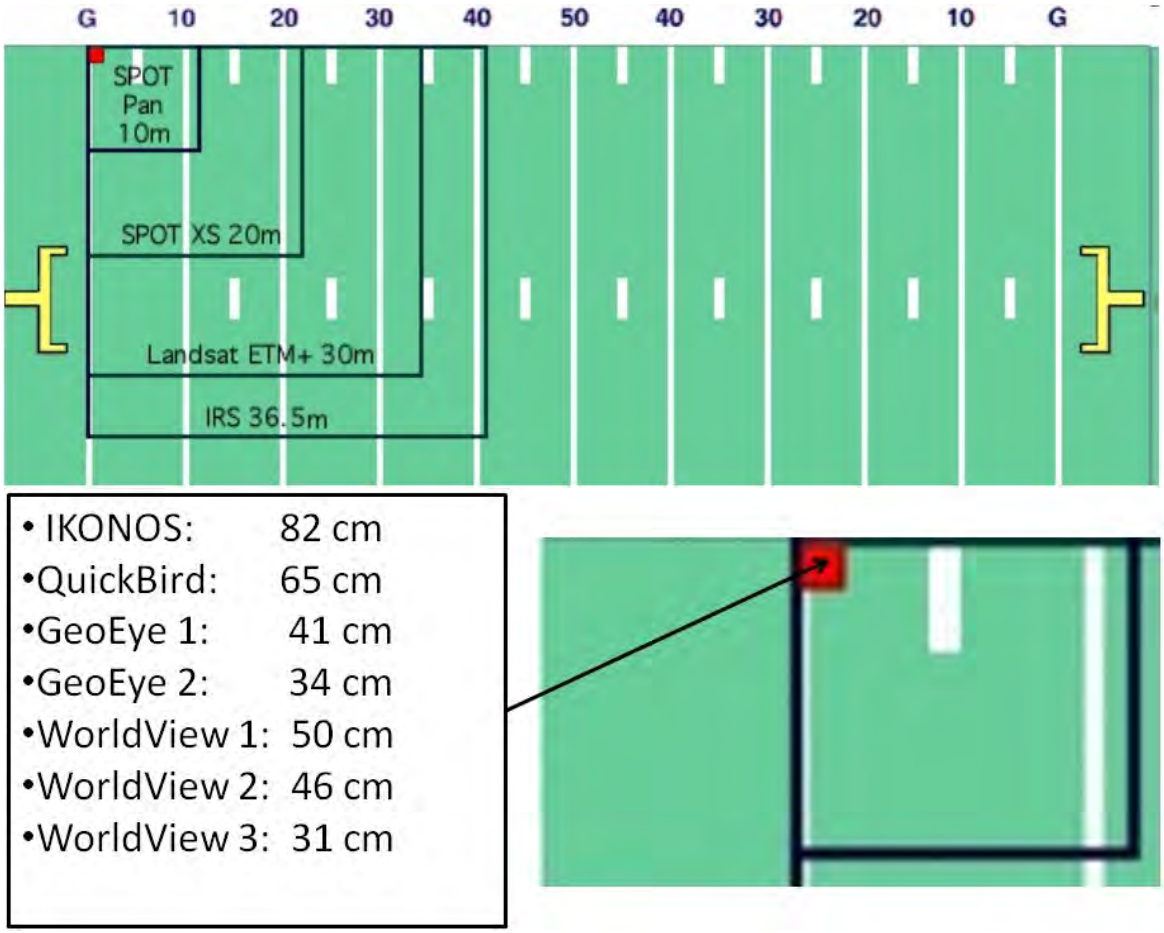

Figure 6. Commercial System Resolution Comparison[68]

The second element after spacial resolution for operator consideration is object sampling, in the case of a single system orbit around the earth, within a certain time frame; this is referred to as temporal resolution. Temporal resolution is a function of the time required for a single satellite to return to the same viewing starting point.

The geographic area that is collected during this orbit is referred to as swath widths and can vary between tens and hundreds of kilometers wide.[69] As depicted in Figure 7, after each orbital lap a new swath of landmass is collected during each rotation. Taking into consideration both the earth's rotation and satellite flight path, most single

[68] Ibid.

[69] Department of Atmospheric Science, University of Alabama, "Principles of Satellite Remote Sensing, Satellite Orbits and Resolution," accessed August 26, 2013, http://noaaaq.itsc.uah.edu/drupal/sites/noaaaq.itsc.uah.edu.drupal/files/module3.pdf.

LEO systems will not return to the same exact spot, or revisit time, for up to three days.[70] This detail is extremely important if new imaging data is constantly required. Unless another asset is available, new information will depend on the individual systems revisit time.

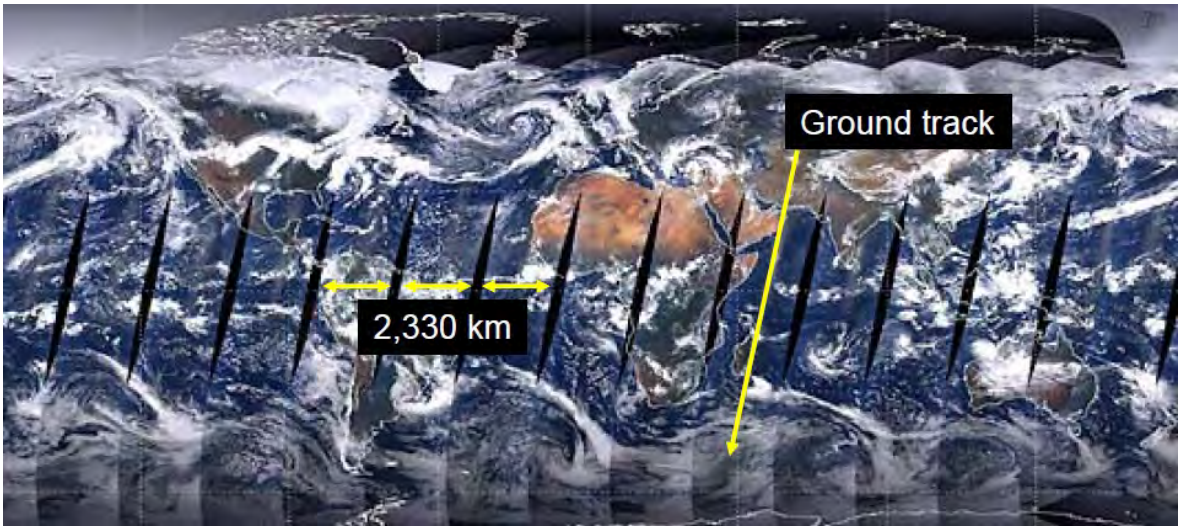

Figure 7. Orbital Swath Width[71]

D. CIVILIAN AND LAW ENFORCEMENT APPLICATION

The domestic uses of government, as well as commercially owned satellite surveillance systems are no mystery. In addition to conducting intelligence collection for U.S. policy makers, the same systems have been used for civilian applications. As early as 1967, in addition to collecting on domestic government facilities, military satellite over flights included several private facilities, including chemical companies Thiocol and Wyandotte, and the metals company Alcoa. Why these particular facilities were imaged were never made clear; however, the missions were classified as "engineering passes," which were conducted post launch to test the equipment sensor capability before they

[70] Remote Sensing Laboratory, Department of Forrest Resources, University of Minnesota, "High Resolution Satellite Imagery and Resource Management," last modified 2011, accessed May 3, 2013, http://water.umn.edu/Documents/HighResolution.pdf.

[71] Department of Atmospheric Science, "Principles of Satellite Remote Sensing,"

were deemed operational to conduct foreign missions.[72] Though not specific, this testing on fixed domestic facilities allowed photo intelligence interpreters, a new skill set at the time, to establish a data set of fixed structure and interpretation analysis.

In addition to military applications and imagery analysis development, the USGS took advantage of these engineering passes to further enhance its mapping capability.[73] As a precursor to emergency management for the purpose of planning for disasters, both natural and potentially manmade, the Office of Emergency Preparedness requested Program CORONA over flights on over a hundred metropolitan relocation sites for the purpose of collecting "precontingency photo coverage."[74]

The lessons learned from these and subsequent over flights were being applied to almost real-time disaster monitoring. As depicted in Figure 8 and Figure 9, pre-event data allows planners to establish, or fine tune, their emergency response activities, and post data allows for those same activities to conduct damage support.

[72] Chairman, COMOR Photo Working Group, "Declassified Memorandum: Revised List of Domestic Targets for KH-4," April 28, 1967, accessed May 4, 2013, http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/02.pdf.

[73] D. C. Truppner to D. H. Steinger, letter, circa July 1968, George Washington University, accessed May 7, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/06.pdf.

[74] Executive Office of the President, Office of Emergency Planning, "Letter to ARGO Steering Group Request for KH-4 Tasking," 1968, accessed July 24, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/06.pdf.

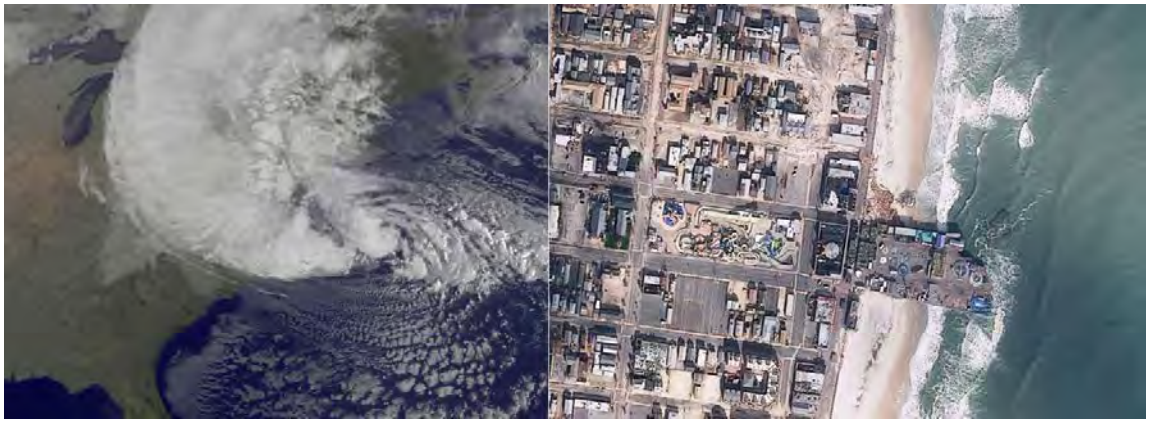

Figure 8. Hurricane Sandy Pre and Post[75]

Figure 9. Yosemite Park Fire, August 26, 2013[76]

[75] Satellite Imaging Corporation, "Hurricane Sandy," October 31, 2012, accessed August 1, 2013, http://www.satimagingcorp.com/gallery/geoeye-1-hurricane-sandy-after.html.

[76] SkyTruth, "Rim Fire, Yosemite National Park," August 27, 2013, accessed September 2, 2013, http://blog.skytruth.org/2013/08/rim-fire-yosemite-national-park.html.

The 9/11 attack provides a classic example of a manmade disaster where quick time imagery was utilized from multiple vectors, as depicted Figure 10. NOAA National Weather satellite services provided area specific data in support of both the Pentagon and lower Manhattan emergency support effort.[77]

Figure 10. Before and After September 11, 2001, at 1 Meter Resolution[78]

On May 1998, President Clinton's Presidential decision directive, "Protection Against Unconventional Threats to the Homeland and American's Overseas" established the concept of National Special Security Events (NSSEs) where a high profile event could be placed in this category depending on its size, likely attendance of both domestic and foreign officials, its domestic or international significance, and level of support past the local jurisdiction level.[79] As a result of this directive:

[77] National Oceanic and Atmospheric Administration, "NOAA's Role in the Nation's Recovery Efforts and the War on Terrorism," *NOAA Magazine*, November 1, 2001, accessed May 3, 2013, http://www.magazine.noaa.gov/stories/mag2.htm.

[78] Remote Sensing Tutorial, "New York, Miami, Atlanta, New Orleans, Houston, Dallas-Fort Worth, St Louis, and Honolulu," November 1, 2005, Federatoion of America Scientists, accessed November 17, 2013, https://www.fas.org/irp/imint/docs/rst/Sect4/Sect4_2.html.

[79] Shawn Reese, *National Special Security Events* (Washington, DC: Congressional Research Service, 2009), 1.

> In 2000, the Presidential Protection Act of 2000 became public law. Included in the bill, signed on December 19, was an amendment to Title 18, USC § 3056 which codified PDD-62. Now, with the support of federal law, the Secret Service is authorized to participate "in the planning, coordination and implementation of security operations at special events of national significance.[80]

NSSEs were placed in this event category because of their potential attraction to a terrorist attack and the likelihood of high casualties if successful. Some examples of NSSEs included presidential inaugurations, state funerals, foreign summits, political conventions, and sporting and entertainment events. As a result of being placed in this category, the full arsenal of federal government support and hardware, including satellite, was brought to bear to ensure the public's safety and the security.

In the case of using national assets for law enforcement actions, with the exception of NSSEs, an example of high profile cases where national assets were used included the Oklahoma City Alfred P. Murrah Federal Building Bombing, the Unabomber, and the DC Sniper investigation.

In preparation for the trial of Timothy McVeigh for the Oklahoma City bombing the federal prosecution team handed a vast array of discovery evidence to the McVeigh defense team. In addition to witness testimony that numbered over 21,000 and over 400 hours of area surveillance video tape, satellite photographs of 20 sites in Oklahoma and Kansas that were taken by intelligence agencies were documented.[81]

In an 18-year investigation that involved over 200 suspects, as it was working its way towards Unabomber Theodore Kaczynski's cabin in Lincoln Montana, the Federal Bureau of Investigation (FBI) took extra steps to mix in with the area surroundings and utilized advanced surveillance methods to monitor their most significant lead. According to Nancy Gibbs from Time International:

> The agents were everywhere, disguised as lumberjacks and postal workers and mountain men. They had draped the forest with sensors and

[80] United States Secret Service, "National Special Security Events," 2012, accessed May 19, 2013, http://www.secretservice.gov/nsse.shtml.

[81] Richard Lacayo and Patrick E. Cole,"The State Versus McVeigh," *Time International*, no. 16 (April 1996): 32.

> microphones, nestled snipers not far from the cabin, even summoned satellites to keep watch for a man practicing blowing things up.[82]

On September 6, 2007, during a Committee on Homeland Security hearing titled "Turning Spy Satellites on the Homeland: The Privacy and Civil Liberties Implications of the National Applications Office," Charles Allen, Chief Intelligence Officer, Office of Intelligence and Analysis, U.S. Department of Homeland Security was queried by Representative Peter King, a ranking member on the Committee on Homeland Security regarding specific details relating to the National Applications Office; an organization that fell under the purview of the DHS Office of Intelligence Analysis. One of the questions that were presented by Representative King to Charles Allen entailed the use of satellite imagery during the October 2002, DC beltway sniper attack. Allen replied:[83]

> I was requested by the Director of Central Intelligence, George Tenet at the time, acting on a request from Director Mueller, to image the interchanges between Pennsylvania and North Carolina, because of the killings that could occur and had occurred along the interstate, because the Bureau wanted the National Geospatial Intelligence Agency to outline the sites, places where snipers might hide. It was used, and Director Mueller, as I recall, was very gratified.

It is very obvious that LE can make many uses of satellite imagery, more often than not, at minimal cost. Shown in Figure 11, imagery can be used to better plan police activities. Before arriving on a scene and in addition to drawing dispatch instructions and mapping data of the surrounding area, the police officer can draw imagery data to provide an extra level of intelligence to better plan scene ingress, egress, and, rural and urban details. The idea is that the more data that the approaching officer has the better.

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[82] Nancy Gibbs, "Tracking Down the Unabomber," *Time International*, no. 16 (April 1996): 24.

[83] *Turning Spy Satellites on the Homeland: The Privacy and Civil Liberty Implications of the National Applications Office, Full Hearing of the Committee on Homeland Security House of Representatives*, no. 110–68, 110th Congress, 1st sess. (2007), accessed February 2, 2013, http://www.fas.org/irp/congress/2007_hr/nao.html, 41–42.

Figure 11. Oblique Satellite Image of School (Top) with 3D Enhancement (Bottom)[84]

E. ORGANIZATIONS THAT EXIST OR HAVE EXISTED

1. The Civil Applications Committee

The first effort to establish a military satellite tasking facilitator for civilian use occurred with the development of the ARGO program in 1968, a precursor to the CAC. Principle membership includes agencies such as the USGS, the Office of Emergency Preparedness, the U.S. Department of Agriculture (USDA), the Agency for International

[84] Google Earth, image, accessed July 31, 2013, http://www.google.com/earth/.

Development, NASA, the Department of Transportation, the Defense Intelligence Agency, and the NRO.[85]

Chartered in 1975, the CAC would make available national assets to civilian activities and "is an interagency committee that coordinates and oversees the civil use of classified collections."[86] Similar to ARGO, the committee maintains a membership of 11 government departments and agencies and is chaired by the Director of the USGS. In addition, DHS has representation through the Federal Emergency Management Agency (FEMA). The purpose of the committee is to provide a liaison with the military and IC to coordinate requests with civilian federal government agencies, state and local governments, academia, and to a lesser extent LE.

Most requests are geared towards climatic studies, natural disaster response, global change investigation, and ecosystem monitoring.[87] All requests are submitted to the committee via the CAC Data Acquisition and Management Team for processing and coordination, where the committee reviews multiple requests at the USGS Advanced Systems Center located in Reston, Virginia.

Primarily in the role of supporting science and policy development, a product that the CAC makes available is the Global Fiducials Program (GFP) in which the USGS maintains an imagery library of key world sites with environmental and earth science specific data.[88] The public can query this information to monitor and study the impact of worldwide change in relationship to atmospheric, oceanic, geological processes, ice and snow dynamics, land use, and land coverage.

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[85] Executive Office of the President, Office of Emergency Planning, "Memorandum for the Record, Subject: ARGO Committee Meeting 10 June 1968," accessed May 8, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/05.pdf.

[86] United States Geological Survey [USGS] Advanced Systems Center—MS562, "The Civil Applications Committee Fact Sheet," July 2001, Federation of American Scientists, accessed November 12, 2012, http://www.fas.org/irp/eprint/cac-fs.pdf.

[87] Bruce F. Molnia, "Monitoring Change as it Happens," *Geospacial Today*, June 2013, accessed June 20, 2013, http://geospatialtoday.com/gst/index.php?view=article&catid=48%3Aarticles&id=3208%3.

[88] United State Geological Survey, "Global Fiducials Library Data Access Portal," January 2013, United State Geological Survey, accessed June 20, 2013, http://gfl.usgs.gov/index.shtml?current=1.

With the exception of disaster related material, which falls directly into the USGS purview, the ability to redirect satellite missions within its control is extremely restrictive, if non-existent. However, what USGS has with regards to quick response data is archived mapping and imagery resources that can be downloaded and integrated onto commercial or government off the shelf GIS packages.[89] As depicted in Figure 12, another USGS web-based product that is available to the public is the National Map Downloader and Viewer. [90] In some cases, though USGS imagery data may be old, it can be updated with newer imagery from other commercial satellite providers. While the ability to have real-time data is often nonexistent, access to mapping and imagery data is not.

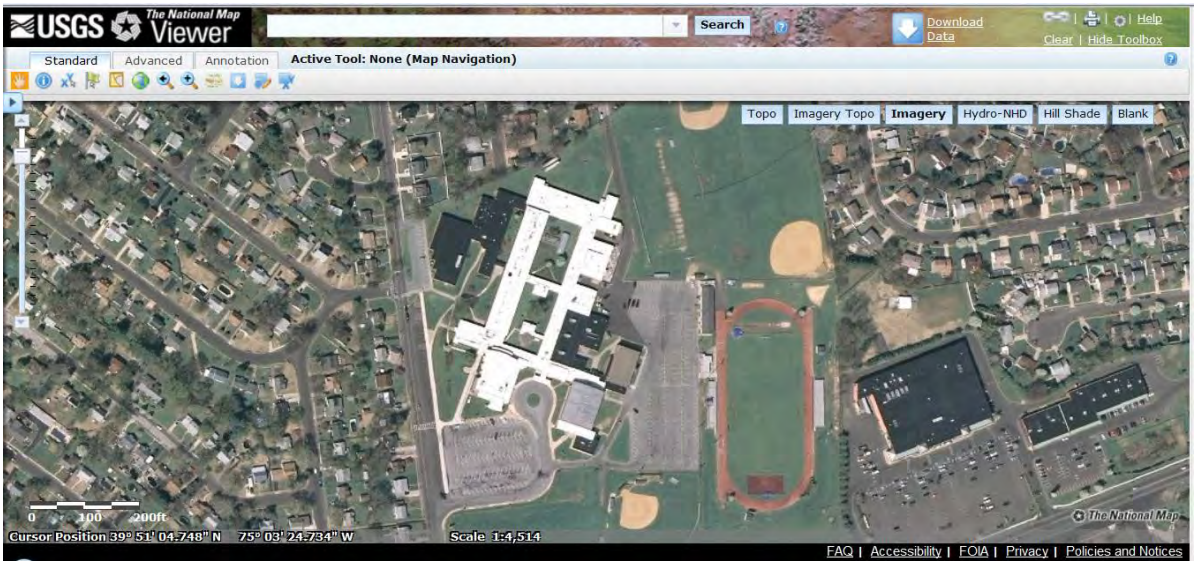

Figure 12. USGS National Map Downloader and Viewer[91]

[89] FalconView is a government off-the-shelf-mapping GIS tool that supports an array of charts and imagery. The package is available free for download at www.falconview.org/trac/FalconView.

[90] The USGS National Map Viewer is a ready source of free mapping and imagery data available through the USGS at http://viewer.nationalmap.gov/viewer.

[91] United State Geological Survey, "The National Map," United State Geological Survey, accessed June 20, 2013, http://viewer.nationalmap.gov/viewer.

2. The DHS National Applications Office

In 2005, the Office of the Director of National Intelligence (DNI) and the USGS commissioned a blue-ribbon panel to identify how the CAC could better facilitate its satellite missions and data request coordination. Several recommendations were made, one of which was to have ready-access to satellite management and data to DHS for the purpose of law enforcement support and emergency management.[92] As a result of the commission's recommendations the DHS National Applications Office (NAO) was established. As a further justification Charlie Allen, DHS Undersecretary for Intelligence and Analysis stated:[93]

> We need to move forward, get the NAO fully operational, and demonstrate how this 21st century capability will greatly aid the work of our scientists, our nation's first responders, and others charged with protecting the United States. The NAO will act as a clearinghouse for available technologies such as overhead imagery to better serve the scientific, homeland security and, eventually, law enforcement communities, with a solid framework to protect privacy, civil rights and civil liberties. It is a good-government solution to assist those users, and there is nothing secretive or mysterious about its mission. In fact, the scientific work of the NAO has been done for more than 30 years by the Civil Applications Committee (CAC), which itself will become part of the NAO. But the CAC model is 30 years old, and the world we live in is far different and, in many ways, more complex than when the CAC was first formed.

As a result of the recommendations presented from the Independent Study Group, the George W. Bush administration established a memorandum of cooperation between the Department of the Interior and DHS,[94] resulting in the establishment of the of the NAO. Starting on May 2007, the DNI appointed DHS as the key manager of the NAO,

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[92] The commission concluded that there was "an urgent need for action, because opportunities to better protect the nation are being missed." It recommended the creation of an entity "to provide a focal point and act as a facilitator to overhead imagery and other resources on behalf of civil, homeland security and law enforcement users." Booz Allen Hamilton, *Civil Applications Committee Blue Ribbon Study*

[93] Charlie Allen, "Why the Country Needs the National Application Office," *DHS Leadership Journal Archive*, July 15, 2008, accessed November 11, 2012, http://www.dhs.gov/journal/leadership/2008/07/why-country-needs-national-applications.html.

[94] United States Geological Survey, "Memorandum of Understanding Between the Department of the Interior Acting through the U.S. Geological Survey and the Department of Homeland Secueiry Pertaining to Geospacial Information and Remote Sensing for Homeland Security," March 13, 2006, United States Geological Survey, accessed April 20, 2013, http://www.usgs.gov/mou/mouwithdhs.pdf.

making it responsible for the new agency's mission, operations, management, and oversight.[95] The NAO's primary functions would include:[96]

1. facilitating access to IC resources and capabilities
2. ensuring IC provided data is used in a lawful and appropriate manner
3. safeguarding privacy civil rights and civil liberties
4. promote the effective use of IC resources
5. share information
6. protect sources and methods
7. provide representation
8. sponsor applications of the CAC and National Capabilities Program; the CAC's lead office

For two years, NAO had direct access to satellite operations and analysis to provide natural disaster and law enforcement support. However, in addition to the office being a redundant activity to the CAC, the concerns of a single government agency having direct access to national assets for the sole purpose of domestic LE surveillance, albeit with significant oversight, drew considerable scrutiny on civil liberty and privacy concerns. On June 23, 2009, DHS Secretary Napolitano shut the office down stating:[97]

> This action will allow us to focus our efforts on more effective information sharing programs that better meet the needs of law enforcement, protect the civil liberties and privacy of all Americans, and make our country more secure.

[95] Richard A. Best and Jennifer K. Elsea, *Satellite Surveillance: Domestic Issues* (Washington, DC: Congressional Research Service, 2011), 6.

[96] National Security Archive, "CHARTER National Applications Office," February 5, 2008, GeorgeWashington University, accessed May 7, 2013, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/48.pdf, 3–5.

[97] Department of Homeland Security, "Secretary Napolitano Announces Decision."

F. DISCUSSION SUMMARY

Fifty years' after Project Corona, the access and technology associated with satellite exploitation has increased exponentially. Packages that entail an extremely high level of imagery resolution quality, which was previously only reserved for the military, is now readily available to civilian users at cost or often free on the internet. The LE application of advanced imagery is very apparent.

Though the specific level of resolution for current national assets is classified, high resolution commercial satellites, which also conduct military and intelligence collection, are actively deployed and provide similar capability with minimal, if no, legal distribution restriction. Prior to the Land Remote Sensing Policy Act of 1992, [98] high resolution imagery, less than one meter, was available to only the military reconnaissance community. Because of the shift of more commercial imagery satellites being deployed just prior to the 1990s, the enactment of the act opened markets for commercial providers to collect and distribute similar high resolution imagery to the civilian community.

In stark contrast to today, when reconnaissance satellites were initially being deployed post-Sputnik, and though the principle mission of military and intelligence collection was apparent, consideration for civil use was formulated with minimal thought for privacy and civil liberty concerns. In the late 1950s and early 1960s, the new technology was in its infancy did not warrant a concern. Today, this is not the case. The concern for another level of advanced surveillance means, though advantageous to LE, is extremely concerning to the citizenry, especially for a system that can indiscriminately blanket an entire populace to find a single target.

Technology is the easy part; it will occur and likely at an exponential rate. However, the public unease of yet another level of surveillance scrutiny will likely increase until a mechanism can be established to assuage the warranted concerns.

The next chapter presents key elements of the law relating to surveillance. Particular consideration will be given to constitutional law, specifically the Fourth Amendment. A case law review will discuss how the Fourth Amendment has impacted

[98] 15 USC, Chapter 82.

surveillance through the ages. Other legal tenets discussed will include both statutory and executive orders concerning the use and restrictions of national assets, the military, and IC in LE activities.

IV. THE LAW

The use of satellite imagery in the context of disaster management and support is a vital tool for emergency services and LE. This application has a long lineage of success dating back to the1960s and 1970s when domestic test flights, or "engineering passes" were used to collect "precontingency photo coverage," and later developed into emergency management plans for U.S. major cities.[99] This was prior to foreign KH-4 imagery collection missions.

With technology very advanced for the time, the future ramifications of satellite surveillance as a domestic collection tool was likely not even considered; to many people it may have still been science fiction. This section will discuss key elements of the law as it relates to surveillance, the legal impact of technology, and its resulting reinterpretation from a constitutional point of view. In addition other relevant legal tenets and case law will be discussed.

A. THE FOURTH AMENDMENT

Technical and operational capabilities are but a small facet to any satellite program, the most significant detail of their use includes the application of law and how, or if, they can be used in an LE activity. Though proper police surveillance is conducted well within the doctrine of the law and is constantly managed by the courts, the use of advanced technology often adds a level of complexity to legal compliance and oversight. The basis of all surveillance law and compliance within our legal system as it is today derives from the Fourth Amendment of the United States Constitution, which states:

> [T]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the person or things to be seized.[100]

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[99] Executive Office of the President, Office of Emergency Planning, "Letter to ARGO Steering Group Request for KH-4 Tasking."

[100] U.S. Constitution, Amendment IV.

From a perspective of surveillance activity, the Fourth Amendment protects the citizenry from unlawful search and seizure. In the framework of advanced surveillance methods, the edict restricts the methods and greatly mandates oversight required in its collection. Unlike a search that involves LE physically being on the questionable property, the introduction of technical means allows potential evidence to be collected from a distance. Traditionally, the Fourth Amendment applied only to cases where there was a physical invasion of property.[101]

Over a hundred years after the ratification of the Bill of Rights, one of the first Fourth Amendment cases relating to the legal validity of advanced technical collection for law enforcement purposes was tested in Olmstead v. United States. [102] The case in question involved Roy Olmstead, who was suspected of unlawfully possessing, transporting, and selling alcohol in violation of the National Prohibition Act. In this case, a portion of the evidence introduced included wiretapped conversations.[103]

The courts determined that the Fourth Amendment's function "was to prevent the use of governmental force to search a man's house, his person, his paper and his effects; and to prevent their seizure against his will."[104] The courts ultimately determined that because investigators did not remove any "tangible material effects" or conduct in any "physical invasion" of property, the Fourth Amendment did not apply.[105] In the Olmstead case, the lack of physical intrusion was key to the case; without it, constitutional violation did not occur. The ruling would remain into effect for almost 40 years until Katz v. United States was decided.

Olmsted v. United States was overruled in 1967 as a result of the findings in Katz v. United States.[106] In the Katz case, Charles Katz moved to have evidence suppressed

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[101] Reginald Short, "The Kyllo Conundrum: A New Standard to Address Technology that Represents a Step Backward for the Fourth Amendment Protections," *Denver University Law Review* 80, no. 2 (2002): 463–466.

[102] Olmstead v United States, 277 U.S. (1928).

[103] Ibid.

[104] Ibid., 463.

[105] Ibid., 466.

[106] Katz v. United States, 389 U.S 347, (1967).

under a claim of a Fourth Amendment violation. He argued that a listening device planted by federal agents while he was wagering illegal betting information in an enclosed public phone booth was unlawfully collecting information.[107] Katz contended that his privacy, within an enclosed phone booth,[108] was violated as a result of an illegal search and seizure conducted in contravention to the Fourth Amendment. During his appeal, it was later determined in the Supreme Court that the Fourth Amendment is applicable to individuals; however, it is not to particular places.[109]

To draw a comparison between Olmstead and Katz, in Olmstead, noncompliance of the Fourth Amendment required an intrusion upon one's property; however, in Katz, it drew the line at "people not places."[110] As a result of that line, the courts ruled in favor of Katz; however, the ruling established a test that would determine individual privacy compliance, as well as constitutional conformity, when applied to future cases. The privacy standard now entails a more nuanced set of criteria where 1) the person must have an expectation of privacy, and 2) the expectation must be reasonable.[111]

The Katz case is a landmark case that brings into question any surveillance used by the government. Extra care by LE, from local to federal jurisdictions, are required to ensure that when required warrant-based approval is required, it takes into consideration the technology to be used. Other pertinent Fourth Amendment cases related to advanced collection methods include Kyllo v. United States, California v. Ciralol, Dow Chemical v. United States, and Florida v. Riley.

In Kyllo v. United States,[112] Danny Lee Kyllo moved to have evidence suppressed under the Fourth Amendment. Upon suspicion that Kyllo was growing marijuana in his residence, the police officers collected thermal imagery of his house; it

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[107] Ibid., 348.

[108] Ibid., 352.

[109] Ibid., 361.

[110] Ibid.

[111] "Katz v. United States," *Case Briefs*, last modified 2013, accessed November 30, 2012, http://www.casebriefs.com/blog/law/criminal-procedure/criminal-procedure-keyed-to-saltzburg/searches-and-seizures-of-persons-and-things/katz-v-united-states-3/.

[112] Kyllo v. United States, 533 U.S. 27, (2001).

was their intension to use this data to acquire a warrant to search Kyllo's home. [113] When the police collected the thermal imaging, it was determined that Kyllo's domicile was hotter than his neighbors.[114] A warrant was subsequently issued and upon search of Kyllo's residence, 100 marijuana plants were discovered, which resulted in his immediate arrest.[115] The question presented, does the use of a device (in this case a thermal imager) used to obtain evidence from a constitutionally protected area, without a physical intrusion, amount to a search under the Fourth Amendment?[116] The key finding from the court determined that Fourth Amendment protections are not conditional upon quality of information to obtain a warrant; even the minutest of intimate details uncovered using thermal imagery from inside Kyllo's house were classified as a search.[117] The courts ruled that the use of thermal imaging prior to the granting of a warrant, similar in Katz v. United States, constituted an invasion of privacy contrary to the Fourth Amendment resulting in Danny Kyllo's case being overturned.

In another case, California v. Ciraolo,[118] the police received information that Dante Ciraolo was growing marijuana in his backyard. However, due to a series of high fences in the defendant's yard, the police could not observe the activity from the adjacent street.[119] To remedy this and prior to obtaining a warrant, the police acquired an aircraft and flew over Ciraolo's home at an altitude of approximately 1,000 feet to get a better view and easily spotted the marijuana plants being grown. Because a fence was installed on his property, Ciraolo argued that there was a reasonable expectation of privacy and that the search constituted an invasion of his privacy in violation of his Fourth Amendment rights. It was determined that the defendant did in fact have a reasonable expectation of privacy on the ground; however, that expectation of privacy did not

[113] Ibid., 29.

[114] Ibid., 30.

[115] Ibid.

[116] Ibid., 31.

[117] Ibid., 37.

[118] 476 U.S. 207 (1986).

[119] Ibid., 216.

include all vantage points.[120] The court determined that the police have a right to share the same area that the public has access to, in this case, public airspace.[121] Because the public could freely look down on Ciraolo's from this location, it was not considered an invasion of privacy under Fourth Amendment protection.[122]

In a case involving a corporation, as opposed to an individual, Dow Chemical Company v. United States,[123] a question was presented to the courts to determine if the use of aerial photography without a warrant constituted a Fourth Amendment violation. In conducting its mission, the Environmental Protection Agency (EPA) gained permission for an on-site inspection of one of Dow's facilities, a 2,000 acre chemical manufacturing plant.[124]After the initial inspection, the EPA requested and was denied a follow-up assessment.[125] The EPA subsequently "employed a commercial aerial photographer, using standard floor-mounted, precision aerial mapping camera, to take photographs of the facility from attitudes of 12,000 feet, 3,000 feet, and 1,200 feet."[126] Upon learning of this activity, Dow brought suit claiming that the EPA violated its Fourth Amendment rights. Similar to the Ciraolo case, these flights were conducted within public airspace and the photographic equipment used, though exacting and designed to collect images in great detail were "commonly used in mapmaking."[127] In its ruling, the court determined that the EPA's aerial photography mission did not constitute a search under the Fourth Amendment.[128]

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[120] Ibid., 212–213.

[121] Ibid., 213–214.

[122] Tyler Pittman, "Constitutional Searches from Space—Part I: California v. Ciraolo and Remote Sensing," National Center For Remote Sensing, Air, and Space Law, University of Mississippi School of Law, July 12, 2012, accessed September 23, 2013, http://rescommunis.olemiss.edu/2012/07/12/constitutional-searches-from-space-part-i-california-v-ciraolo-and-remote-sensing/.

[123] Dow Chemical Co. v. United States, 476 U.S. 227 (1986).

[124] Ibid., 229.

[125] Ibid.

[126] Ibid.

[127] Ibid., 231.

[128] Ibid.

In yet another case, Florida v. Riley[129] challenged the constitutional legitimacy of collecting within a curtilage[130] of private property. Upon receiving a tip, the police utilized a helicopter to observe Michael Riley's property to determine if he was growing marijuana.[131] After circling at 400 feet in a helicopter, the police were able to identify marijuana plants growing in an enclosed greenhouse that had two roof panels missing.[132] As a result of the direct observation of inside of Riley's greenhouse, a warrant was executed resulting in Riley's property being searched, the marijuana discovered, and, ultimately, his subsequent arrest. [133] This was similar to the cases involving Dow and Ciraolo where the observations were conducted in public airspace.

According to the courts on Florida v. Riley, three factors are essential in invoking Fourth Amendment protection: 1) the surveillance was sufficiently rare, 2) the surveillance interfered with the normal use of the curtilage, and 3) the surveillance detected intimate details connected with the home or curtilage.[134] There may have been a rationalization for claiming that the greenhouse was a curtilage and an enclosed structure; however, because the illegal crops could be seen as a result of the missing panels, the greenhouse was not considered a secure curtilage at that time. As a result, the expectation to privacy was nullified, and the surveillance was not considered a search under the Fourth Amendment.[135]

Satellite imagery, which features images from above, is becoming more available to all sectors of society. Though dated, an individual can query the web and view household activity just by observing the image collected For example, an individual can determine: if there was an addition to a house built, who was home (by looking at parked

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129 Florida v. Riley, 488 U.S. 445 (1989).

130 Curtilage is an area, usually enclosed, encompassing the grounds and buildings immediately surrounding a home that is used in the daily activities of domestic life. *Black's Law Dictionary Free Online Legal Dictionary* (2nd ed.), s.v. "curtilage," accessed November 19, 2013, http://thelawdictionary.org/curtilage/.

131 Florida v. Riley, 488 U.S. 445 (1989).

132 Ibid.

133 Ibid., 449.

134 Ibid., 451–452.

135 Ibid.

cars), if a person maintain the property, and a host of other information. The image is taken from the airspace above the domicile or property in question.

California v. Ciraolo, Dow Chemical Corporation v. United States, and Florida v. Riley were all cases where the key evidence was collected via aerial surveillance. Though somewhat surreptitious in nature, all of this evidence was collected in an area where the common citizen has free access to, public airspace. This holds true today. Clearly, the majority of the public does not routinely venture in the realms of space; however, that same public has ready access to space borne sensor equipment by merely connecting to the web. In its primacy, the government significantly restricted the availability of satellite imagery to the public, and rightly so. However, with the commercial sector maintaining a large share of the industry, the access to greater satellite sensor capability will be on hand for all. Katz and Kyllo were landmark cases that changed constitutional interpretation as it relates to technology. Time will show that though constitutional doctrine is sacred, levels and expectations of privacy will also change as technology evolves and societal norms are reconsidered.

B. THE POSSE COMITATUS ACT AND EXECUTIVE ORDER 12333

Though national assets are routinely used in disaster management and support,[136] the question is often asked about the inability of LE to readily use the same equipment to conduct criminal activities. The answer is that the Posse Comitatus Act (PCA) prohibits the U.S. military from directly taking part in law enforcement; PCA makes it clear that it is a crime for an individual or activity:

> Whoever, except in cases and under circumstances expressly authorized by the Constitution or Act of Congress, willfully uses any part of the Army or the Air Force as a posse Comitatus or otherwise to execute the laws shall be fined under this title or imprisoned not more than two years, or both.[137]

[136] The Stafford Act, 42 U.S.C. §§ 5121 allows for national assets to be readily used for natural and manmade disaster support.

[137] 18 U.S.C. § 1385.

Questionable PCA activity, when not properly administered, can occur in the arena of LE support. Being owned and operated by either the military or IC, the use of national assets by an LE activity from a legal perspective is very restrictive. A key test in its compliance indicates that:

> The Courts have held that, absent a recognized exception, the act is violated (1) when civilian law enforcement officials make "direct active use" of military investigators, (2) when the use of the military "pervades the activities" of the civilian officials, or (3) when the military is used so as to subject citizens to the exercise of military power that is regulatory, prescriptive, or compulsory in nature.[138]

Though the act is extremely restrictive in what the military can and cannot provide, [139] it still allows the military to engage in activities that will support or incidentally benefit LE; an example, to name a few, would include participation in joint exercises and training.

In some cases, Congress has exempted PCA, through the Military Cooperation with Law Enforcement Officials Act of 1981,[140] from activities involving drug interdiction and operations within U.S. borders to more recently the war against domestic terrorism. An example of a high profile criminal investigation that used military resources involved the investigation of the DC beltway sniper attacks during the fall of 2002. The FBI asked for and received support from the DoD to provide aerial surveillance of the Washington metro area using an Army RC-7B with sensor equipment to potentially pinpoint gunfire. Though the flight crew and sensor operators were military personnel, they were managed by and reported to civilian law enforcement, thus making the military/civilian LE relationship completely PCA compliant.[141] The military is forbidden to engage in direct LE activity,[142] including both investigation and arrest powers; however, the military is empowered, with prior approval, to provide indirect advice, support, and equipment.[143]

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[138] Best and Elsea, *Satellite Surveillance: Domestic Issues*, 19.

[139] The *PCA* surprisingly does not specifically apply to the Navy or Marine Corps.

[140] 10 U.S.C. §§371–378 (2001).

[141] Christopher M., Petras, "Eyes on Freedom-A View of the Law Enforcement Use of Satellite Reconnaissance in U.S. Homeland Security," *Journal of Space Law* 31, no. 1 (2005): 111.

[142] Unless, under 10 U.S.C. §§ 382 (2001), direct action is "considered necessary for the immediate protection of human life, and civilian law enforcement officials are not capable of taking the action."

[143] 10 U.S.C. §§ 382.

For example, in United States v. Hartley and Murphy,[144] Allen Hartley and John Murphy were arrested for illegally transporting marijuana into the United States. Both contested that evidence was seized during a military operation and should have been excluded on the grounds of a violation of the PCA.[145] A military operation was occurring at the time where Air Force flight crews of the 552nd Airborne Warning and Control Systems (AWACS) Wing conducting training.[146] Also on this particular training flight was a United States Customs Service (USCS) agent who was assigned to a sensor station. Both the USCS and Air Force had a joint program that allowed civilian agents to fly onboard military aircraft on a space available basis.[147] During this mission, the onboard military liaison officer to the USCS spotted an unidentified aircraft approaching United States territory. The observing airborne USCS agent also tracked the unidentified aircraft and radioed Customs officers of its flight; at no time did the Air Force stop its original training mission.[148] The Customs service subsequently intercepted and tracked the unidentified aircraft. The USCS agent on the AWACS continued monitoring the aircraft when it landed on an unfinished highway in Louisiana and shortly took off.[149] When Customs agent and non-military officials arrived at the landing site, they found a large quantity of marijuana and Allen Hartley, who was subsequently arrested. The USCS agent onboard the AWACS continued monitoring the aircraft after it took off and tracked it until the aircraft landed in Mississippi where John Murphy was arrested.[150] At no time were the military directly involved in the LE activity; as a result, the courts denied the motion to suppress the evidence based on a Posse Comitatus Act violation.[151]

144 United States v. Hartley and Murphy, 796 F.2d 112 (1986).

145 Ibid., 113.

146 Ibid.

147 Ibid.

148 Ibid.

149 Ibid., 114.

150 Ibid.

151 Ibid.

In United States v. Roberts and Hawk,[152] James Roberts and Clifton Hawk were arrested on the high seas while transporting marijuana on their vessel the *Sea Waltz*; both contend that the United States Navy participation in their arrest was in violation of the PCA.[153] The *Sea Waltz* was observed 130 miles west of Mexico and 1800 miles south of San Diego by the *U.S.S. Reid*, a Navy guided missile frigate.[154] As part of a Navy and Coast Guard joint cooperation effort, five Coast Guard personnel were on board the *U.S.S Reid* to conduct law enforcement missions.[155] The Coast Guard contacted *Sea Waltz*, a 41 foot sailboat, by radio to announce its intension of boarding the vessel.[156] The Coast Guard team was dispatched by the *U.S.S. Reid* in a boarding boat with a Navy crew.[157] As the boarding party approached *Sea Waltz*, the smell of marijuana became apparent.[158] When *Sea Waltz* was boarded multiple bales were discovered; after one of the bales tested positive for marijuana, it was taken in as evidence and the *Sea Waltz* crew, including Roberts and Hawk, were arrested and taken onboard the *U.S.S. Reid*.[159] The *Sea Waltz* was towed; however, after taking on water, and due to the inability of the Coast Guard crew to further salvage the vessel, it was shot with gunfire from the *U.S.S. Reid* and sank.[160] Though the Navy supported the Coast Guard operation, by providing equipment and personnel support, the Coast Guard directed the law enforcement operation; as a result the courts denied the arrest operation was unlawful due to Posse Comitatus Act Violation.[161]

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[152] United States v. Roberts and Hawk, 779 F.2d 565 (1986).

[153] Ibid., 567.

[154] Ibid., 566.

[155] Ibid.

[156] Ibid.

[157] Ibid.

[158] Ibid.

[159] Ibid.

[160] Ibid., 567.

[161] Ibid., 569.

Where PCA specifically restricts the military, Executive Order (EO) 12333[162] is designed to restrict the role of the IC. The order prohibits the IC from collecting, investigating, and distributing data on U.S. citizens; however, similar to PCA, EO 12333 has language that allows the IC to support LE in domestic spy cases, terrorism, and drug activities.[163] Other key elements of the order specifies that the support activity must also be coordinated and approved by the providing activity and Attorney General.[164] This is similar to PCA, in that it allows the use of equipment and assistance to local LE[165] when approved and mandates "the least intrusive collection techniques feasible within the United States or directed against United States persons abroad"[166] The order also makes clear that "Nothing in this order shall be construed to authorize any activity in violation of the Constitution or statutes of the United States."[167]

With the availability of commercial satellite providers becoming increasingly prevalent, along with the accompanying sensor capabilities that may be more than adequate to prepare LE operational plans, the use of national assets for domestic purposes may begin to wane except for a high profile national security events.[168] As more commercial systems are incorporated into local LE activities, PCA or EO 12333 will not have to be considered. If the use of real-time data is required for an operation, aerial or UAS flights will fill the gap further negating the legal concern for military or IC support compliance.

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[162] 46 Fed. Reg. 59,941 (1981), as amended by Executive Orders 13284 (2003), 13355 (2004) and 13470 (2008).

[163] Ibid., Paragraph 2.6.

[164] Ibid.

[165] Ibid.

[166] Ibid., Paragraph 2.4.

[167] Ibid., Executive Order 12333, Paragraph 2.8.

[168] An example may include an NSSE, covered under the Presidential Protection Act of 2000, or natural and manmade disasters requiring government satellite support.

C. CONCLUSION

Several topics were presented regarding the application of satellite surveillance in relationship to the law. Though the ability to use equipment that streamlines a surveillance operation is available in many variants, and can be applied from many vectors, consideration of the law is paramount. Surveillance, if improperly conducted, is a very easy aspect of an investigation that can be challenged in a court of law; judicial compliance and oversight is vital to its unimpeded use in the courts. The complexity of the law in comparison to technology is apparent; since Katz,[169] and maybe as early as Olmstead[170] when technology was first challenged, the constant retooling of the Constitution is apparent; and necessary.

A key constitutional question presented in all of the aforementioned cases indicated that if an observation was being conducted in a thoroughfare where the public has free access, then that observation was not a search per the Fourth Amendment; many examples were presented on police over flights in public airspace. The same can be presented of Riley[171] doing a reasonably decent job of maintaining a marijuana growing operation within the curtilage of his property, however mismanaging the integrity of the curtilage itself; the second that his greenhouse enclosure was opened and could be observed from public airspace, at that very moment, Riley no longer had a Fourth Amendment case.

Similar questions could be presented with regards to PCA; with the best tools available for military and intelligence collection, how come they are not regularly used to investigate criminal activity on American soil? Case law indicates that the application of military equipment and talent clearly benefits the LE cause. Though the military and IC have superior surveillance tools and personnel to operate it, does the American citizenry want them playing a direct role in law enforcement; probably not. And with commercial satellite resources becoming more available, is it necessary? As new surveillance

[169] Katz v. United States, 389 U.S 347, (1967).

[170] Olmstead v. United States, 277 U.S. 438, (1928).

[171] Florida v. Riley, 488 U.S. 445 (1989).

technology and methodology occur, judicial parties and the courts will be challenged to ensure that the law is keeping up, yet at the same time ensuring that base legal doctrine is not compromised.

The next chapter will present various policy options for considerations. Using an analytical framework and method, a discussion will be presented describing each program's pros and cons, and a graded determination will identify an optimum approach for LE to acquire imagery support.

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V. METHODOLOGY AND RESEARCH ANALYSIS

This thesis is exploring various options where LE can gain greater access to imagery through national assets, or a suitable alternative. Key questions were discussed to identify and analyze potential courses of actions. First, what would the likely legislative confidence and support be? Second, what level of legal issues will need to be explored? Third, what would a notional projected cost be? Finally, what would be the program's relative ease of implementation?

Allowing the use of satellite imagery on the surface provides many benefits to police surveillance and investigation. When satellite surveillance is presented in non-technical generalities to the general public towards its utility on a foreign battle field, or a domestic disaster zone, the level of acceptance is very apparent. Though likely compartmentalized and watered down, in comparison to raw data, the citizenry more than welcomes the opportunity to view what government based satellites are presenting to planners.

From a macro perspective the American public finds this surveillance acceptable. As previously mentioned, if criminal activity in the form of environmental exploitation or similar against the community can be identified using this data, it is very unlikely that there would be significant disagreement on the circumstances of its collection and its application in a court of law. Though there is no record of its employment, the same may be said if satellite imagery could be used as evidence during a high profile criminal offence against American society as a whole; the 2013 Boston Marathon bombing may be a perfect example.

However at the micro level against an individual who may not be engaged in a high profile crime or a wrong against the community, society often balks at this level of surveillance. In contrast to most countries, the American notion of living in any degree of a surveillance state, whether in plain site or not, often exudes a feeling of interference in an individual's life to a level of healthy, or unhealthy, paranoia; in comparison to a pre-digital way of life, a person could very easily lead a rather anonymous life. From a

members of the public point of view this activity, though likely justified in many cases, raises several levels of warranted concerns of how their individual data points are collected, archived, managed, and why. With technology as exacting as it is, why are the innocent being mixed in among the guilty often with a broad band collection method; is there a system of separating the good from the bad?

A. METHODOLOGY APPROACH

The mode of analysis to be utilized for this study will be a policy options analysis. This methodology provides the best path because it studies a program that may be inefficient or unworkable, compares it to other similar programs, identifies what works and doesn't, draws a comparison of each, and determines an optimum program approach. For the purpose of identifying and examining current programs, modified programs, and notional programs not in existence as a potential singular LE satellite surveillance methodology, the "eightfold path" for policy analysis, was utilized. This approach, which was promoted by Eugene Bardach, from the Goldman School of Public Policy, University of California, provides a method that unto itself takes an extremely complex process, breaks it down into eight simple steps from defining the problem to deciding an approach, and identifies an optimum policy option.

According to Bardach, and in the context of this policy analysis, the following steps include[172]:

Step 1. Entails defining the problem; for the purpose of this thesis, the relative inability for LE to acquire imagery derived from national assets along with the requisite analysis and interpretation support; as well as the American public's concern for potential unfettered and unwarranted invasion of privacy and civil liberties in contrast to Constitution laws.

Step 2. Involves collecting data to populate the analysis process; in this topic several similar yet diverse elements needed to be addressed. The easiest subject to cover included the historical aspects of early satellite programs and the integration of civilian agencies into an only-military and IC only

[172] Eugene Bardach, *A Practical Guide for Policy Analysis* (Los Angeles, CA: CQ Press, 2012).

association. From a technical aspect there is a trove of information from government, academia, and industry sources; the complexity of science involved the significant advancements in system's capability in a very short amount of time. A topic of major intricacy in comparison to history and technology was the vast array of legal statutes relating to the use of national assets, and their impact to privacy and civil liberty statutes.

Step 3. Includes identifying alternative approaches or solutions to address the problem. The LE community often has sporadic satellite imagery support from the CAC. A problem with this approach includes the inability for local LE to acquire data unless a high profile event is occurring, for example a natural or manmade disaster. A solution presented and enacted within DHS was the establishment of the NAO, an organization that would work more directly with the LE. Another option that is routinely used, especially at the local level, is the use of imagery data direct from commercial satellite providers.

Step 4. Established the evaluative process that will be used to compare and contrast policy alternatives. A core element in the process will be to identify essentials that play a major role in each policy option, and identify individual pros, cons, and an eventual grading matrix that can ultimately rank options. At a minimum, alternatives will need to take into consideration key elements to include legislative support, legal complexities, likely cost, and ease to implement.

Step 5. Taking into consideration the variables from the previous steps, projects an outcome of each policy option. Inherently the most complex of steps, it is in this area where lessons learned and necessary rating information is compiled. This thesis will identity three potential options; to generalize: 1) can a mission be accomplished with an existing office with supplemental funding to further support LE, 2) can a shut down office, previously established to provide surveillance support directly to LE, be reopened to continue its mission, and 3) in order to eliminate bureaucratic

entanglements, which is unfortunately associated with government programs, could more streamlined tasking be accomplished through the use of private satellite servers?

Step 6. After conducting an analysis of each policy option, identifies the tradeoffs that each idea presents. Like any exercise in the analysis of multiple activities, benefits and drawbacks will be identified. Though it would be easy for all the positive qualities to be lumped in one option thus making the policy analysis option easy, this is all too often not the case. This process will identify a range from workable elements to barriers that will be the key to narrowing the policy option ranking.

Step 7. Consists of taking all the background data and conducting an analysis of all the options presented.

Step 8. Provides a background of all options, a thorough analysis of each, and ultimately an optimum policy choice.

B. POLICY OPTIONS ANALYSIS

There exist, in present and past programs, multiple options that can be explored where lessons learned and mistakes encountered have occurred. The analysis investigated three policy options that could support LE operations; one being an existing federal program, the second being a former federal program, and the third being a nongovernment owned activity.

1. Policy Options

The following are three concepts that were explored. Option one consists of supplementing the CAC to further support LE, option two consists of reestablishing the now defunct NAO, and option three would consist of eliminating altogether government support, with the exception of disaster management, and having the duty of imagery collection through commercial providers managed at the lowest LE level. All choices have varying degrees of pros and cons; in addition all need to take into consideration a level of legislative, public, and LE support to be viable for success. Key elements of likely success also included:

- the ability to quickly acquire imagery data with minimal bureaucratic issues
- a greater use of all satellite systems, both government and commercial
- a system that would include imagery analysis support
- a legal oversight system mechanism
- program transparency

a. Policy Option 1: Further Supplement the CAC to Support LE

One approach would be to maintain satellite operations and coordination within the federal government realm using the CAC as the sole LE provider. The CAC currently provides scientific and disaster management imagery to requesting activities using the USGS as the principle conduit for both military and IC national asset resources. This service is a proven and vital function and could be expanded to accommodate mission specific LE activities to include criminal investigation and operational planning.

Individual agencies can often draw imagery information directly from web-based commercial sources, and more often than not this data is adequate; however, though useful the imagery is likely dated.[173] Often the success of a law enforcement activity or operation is dependent on the currency of the resources available; GIS sources to include both area specific mapping and imagery. An additional support function, which the CAC readily maintains, would include:

1. Imagery Analyses: this activity would provide imagery analysis to include both urban and rural topographic interpretation and characterization
2. Legal Analysis: this activity would provide support in the legal compliance of imagery use
3. Technical Aid: this activity would provide organizational recommendations, training, and assistance in establishing in-house GIS activities

[173] Though updated periodically, Google Earth data is typically one to three years old. Google, "Google Earth Frequently Asked Question," last modified 2013, accessed August 22, 2013, https://support.google.com/earth/answer/187961?hl=en.

To consolidate imagery request at the most local level, a GIS request system will be studied and considered where LE activities can coordinate their individual request through respective Fusion Centers or in the case of large jurisdictions directly with the CAC.

b. Option 2: Reestablish the National Applications Office

The second approach would be to reestablish the NAO, which was shutdown in 2009, and reassume the role of a central facilitator of imagery support. The organization was specifically established to act as an LE clearing house for national asset data under the umbrella of DHS.

The circumstances of the NAO's short life span was the result of DHS's inability to be properly establish the activity from the very beginning[174]; however, its overall mission was innovative in concept and attempted to make available the most advanced tools in the government arsenal to the LE community. Unlike the CAC, whose principle support was geared more towards the scientific community and emergency service, the NAO was designed specifically to assist LE.

Similar to the CAC; in addition to providing imagery data, ancillary support would also include imagery analysis, legal analysis, and technical aid.

Another item to consider is moving the activity to a DHS LE conscious directorate. The NAO was originally housed within the DHS Office of Intelligence and Analysis Directorate; though in some sectors the use and application of satellite imagery can be more associated in an intelligence activity, it should have been placed in a complimentary LE-based directorate; a more appropriate directorate would be the Office of Operations and Coordination. DHS's Operations and Coordination Directorate

[174] Best and Elsea, *Satellite Surveillance: Domestic Issues*, 7–8.

organizational function is to coordinate with LE activities between DHS and "federal, state, territorial, tribal, local, and private sector partners by collecting and fusing information from a variety of sources."[175]

c. Policy Option 3: Make Greater use of Commercial Providers

An option not explored as an institutional source, but routinely used on an as need basis from a city or municipality standpoint, is to make greater use of commercial satellite providers. With the exception of readily available streaming data, which in emergency can be collected either by aerial or unmanned aircraft system (UAS) surveillance, the private industry can provide ample imagery and sensor data for multiple uses and customers. For example, DigitalGlobe is a major provider of imagery services with a fleet of GeoEye-1, GeoEye-2, IKONOS, and Worldview[176] imagery satellites; the technologies provided are almost equal to government agencies[177].

The collection of satellite imagery data would be geared towards taking greater advantage of commercial services, as opposed to government resources. This would put the onus on the specific LE activity to facilitate individual imagery requests directly with the satellite provider. Several imagery resources, including at-cost and free web-based services with the requisite GIS analysis packages, are readily available. Though information may be dated, often it is current enough and has more than adequate resolution to be used for planning purposes.

Removing the federal government and empowering LE at the lowest level will lessen excessive bureaucratic formalities, reduce the impact of some legal issues, and, in comparison to federal government collection efforts, may in fact reduce the specter of infringement of privacy rights.

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[175] Department of Homeland Security, "About the Office of Operations Coordination and Planning," last modified 2013, accessed November 19, 2013, http://www.dhs.gov/about-office-operations-coordination-and-planning.

[176] DigitalGlobe, "Satellite Resources," June 2013, http://www.digitalglobe.com/resources/satellite-information.

[177] Weber and O'Connell, *Alternative Futures*.

2. Policy Options Grading Criteria

The three policy options to be investigated were graded using the following criteria: 1) legislative support, 2) legal issues, 3) projected cost, and 4) ease to implement. The details of each criterion are presented below.

a. Legislative Support

Legislative support would gauge the likely confidence of legislators who would enable the proposed program to secure funding and be sustained. There are some questions to consider, such as: What level of legislative acceptance or resistance can be expected? Will past program successes or failures impact future proposals? If legislative support is lacking, a low grade can be anticipated or determined, due to proposal complexity, controversy, skepticism, etc. In contrast a high grade may be anticipated or determined, if legislative support is positive due to transparency, constructive documentation, public acceptance, etc..

b. Legal Issues

The legal issues criterion identifies whether a suggested policy option solution would garner questionable or excessive legal scrutiny. Several questions should be considered: How many legal statutes will need to be considered? What level of privacy and civil rights issues will arise? Will imagery data collected be admissible in the courts? How many challenges can be expected? A low grade can be expected if it is anticipated or determined that vital legal tenets will not be addressed or pushed to their maximum acceptable limitations. On the other hand, a high grade can be expected if all applicable legal tenets are covered and well within acceptable boundaries.

c. Projected Cost

The projected cost criterion anticipates the level of resources that will be necessary to enact the policy option. Some questions for consideration are: Will new funding be required for a new organization or supplemental funding to an existing activity? Will there be buy in from other activities or will a single program have to incur the full financial burden? If a program cost will exceed the options utility then a low

grade will be assigned. In contrast, a high grade can be anticipated if costs are manageable or if there is cost sharing from other organizations.

d. Ease to Implement

The final criterion is ease to implement, which identifies the level of ease in enacting the policy option. A couple of questions should be considered: Will it be necessary to establish a new activity or modify an existing one? Is an infrastructure and support system in place to accommodate the policy option? If there is minimal, existing infrastructure to support the option it will receive a low grade. However, a high grade will be given if there is existing infrastructure to support the option.

C. POLICY OPTIONS EVALUATION

The three policy options are as follows: Policy Option 1: Further supplement the Civil Applications Committee to support LE, Policy Option 2: Reestablish the National Applications Office, and Policy Option 3: Make greater use of commercial providers. An evaluation was conducted of the three policy options utilizing the policy options grading criteria. The details of each option in relationship to the established grading criteria are presented below.

1. Policy Option 1: Further Supplement the Civil Applications Committee Evaluation

In addition to disaster support, can LE be further supported if additional funding and resources were provided to the Civilian Applications Committee? An evaluation of Policy Option 1 in relationship to the grading criteria is discussed.

a. Policy Option 1: Legislative Support

A benefit that the CAC has, along with its parent agency the USGS, is it inherently does not work under a veil of secrecy similar to its military or IC counterparts. The imagery that USGS collects is principally for scientific purposes, a byproduct of which, in the form of raw data, is available to the public. For example, the CAC's GFP

and National Map are clear examples of where tax dollars are being spent and provide a daily example of access to free mapping and imagery for anyone with web access—LE included.

As a whole, the indirect legislative support may stem from the CAC's parent agency to internally support it as a conduit for the LE community in disaster monitoring and management. For example, though federal budgets are waning across the board, the USGS Core Science Systems, National Geospatial Program budget, which houses the National Map, has had an increasing budget of $63 million in 2012 to a $72 million justification in 2014.[178]

b. Policy Option 1: Legal Issues

An element that works with the CAC with regards to the law, particularly constitutional privacy as well as PCA compliance, is its specific mission profile when it comes to coordination of services with the military and IC. The activity is primarily designed to support civil agencies and academia in earth science programs and subsequently support policy makers in related and collaborative matters. Because of the program's direct scientific-based missions, it simply does not garner the legal scrutiny. In addition, the CAC currently does not conduct criminal LE investigation support. What the CAC does provide is emergency service support for natural and manmade disaster events. The satellite data it provides is used by emergency managers for pre and post disaster planning; the complexities of surveillance legalities do not fall within this realm.

c. Policy Option 1: Projected Cost

From an emergency management perspective, the CAC is vital for providing satellite imagery for states and local jurisdictions in pre-planning and post disaster support. The program has been maintaining this function since 1975.[179] However, though this function is designed to support LE, strictly in terms of emergency

[178] United States Geological Survey, *Budget Justifications and Performance Information Fiscal Year 2014* (Washington, DC: United States Departmrnt of the Interior, 2013), accessed September 1, 2013, http://www.usgs.gov/budget/2014/greenbook/2014_greenbook.pdf.

[179] USGS,"Civil Applications Committee Factsheet."

management and not criminal investigation. In addition, the service is not extended towards LE operational planning, including rescue team, active shooter, or similar scenario development.

Despite the increase in the USGS Core Science Systems budget, the CAC's resources has in fact been consistently waning from $2 million in both 2010 to 2012[180] to manage the activity, to an agency justification of -$576,000, with a loss of two full time employee billets in 2014.[181] Another organization shift was in the 2010 budget language, which specified that none of the funding, with the exception of disaster support, was to be used for LE purposes.[182]

In 2007, there was a comprehensive redesign of generating a national imagery repository, referred to as the Imagery for the Nation (IFTN), [183] in which the USDA and the USGS funded the development of a cost benefit analysis for the necessary satellite and aerial imagery to update, enhance, and standardize a national imagery program. The National States Geographic Information Council (NSGIC) was tasked to prepare a notional plan. The NSGIC organizational mission is to provide a coordination activity for state and local government agencies to acquire and manage up to date imagery requirements in accordance to the National Spatial Data Infrastructure (NDSI).[184]

The IFTN presented four options,[185] which included a variation of 1) full federal funding, 2) 50/50 federal and state funding, 3) imagery at one meter resolution for

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[180] Richard M. Jones, "FYI: The AIP Bulletin of Science Policy News, House FY 2010 USGS Appropriations Bill," June 25, 2009, American Institute of Physics, accessed June 22, 2013, http://www.aip.org/fyi/2009/082.html.

[181] United States Geological Survey, *Budget Justifications and Performance*, B-57.

[182] Richard M. Jones, "FYI: The AIP Bulletin of Science Policy News, House FY 2010 USGS Appropriations Bill," June 25, 2009, accessed June 22, 2013,http://www.aip.org/fyi/2009/082.html.

[183] National States Geographic Information Council, *Imagery for the Nation, Cost Benefit Analysis* (Bel Air, MD: National States Geographic Information Council, 2007), accessed September 9, 2013, http://www.nsgic.org/public_resources/Imagery_for_the_Nation_IFTN_CBA.pdf .

[184] The goal of this program, which is managed by the Federal Geographic Data Committee, is to provide a means of coordination among agencies to improve mapping and imagery standardizations, data quality, reduce cost, establish LE relationships along all sectors, and make data readily available to the public at http://www.fgdc.gov/nsdi/nsdi.html.

[185] National States Geographic Information Council, *Imagery for the Nation*, 2–5.

the entire nation, 4) imagery at one foot resolution for the rural/urban environment, and 5) imagery at 6 inch resolution in the urban environment. To specify:

1. IFTN Option 1[186]
    a. Proposed cost: estimated $1.38 billion for 10 years to aerial and satellite imagery provider support.
    b. 100 percent federally funded base line and annual update of 1-meter imagery for the entire nation; Hawaii will receive a base line and update every three years; Alaska will receive a base line and update every five years.
    c. 100 percent federally funded 1-foot resolution imagery, updated every three years, for states east of the Mississippi.
    d. 100 percent federally funded 1-foot resolution imagery, updated every three years, for all counties west of the Mississippi with a population center greater than 25 people per square mile.
    e. 50 percent federal matching funds will be available to agencies to acquire 6-inch imagery data to city areas that have a population greater than 50,000 or a population density of 1,000 people per square mile.
2. IFTN Option 2[187]
    a. Proposed cost: estimated $1.73 billion for 10 years to aerial and satellite imagery provider support.
    b. 100 percent federally funded base line and annual update of 1-meter imagery for the entire nation; Hawaii will receive a base line and an update every three years; Alaska will receive a base line and an update every five years.
    c. 100 percent federally funded 1-foot resolution imagery, updated every 3 years, for all states and Hawaii.

[186] Ibid., 4–5.

[187] Ibid., 4–8.

d. 100 percent federally funded 1-foot resolution imagery, updated every three years, for all counties in Alaska with a population center greater than 25 people per square mile.

e. 50 percent federal matching funds will be available to agencies to acquire 6-inch imagery data to city areas that have a population greater than 50,000 or a population density of 1,000 people per square mile.

3. IFTN Option 3[188]

a. Proposed cost: estimated $1.71 billion for ten years to aerial and satellite imagery provider support.

b. 100 percent federally funded base line and annual update of 1-meter imagery for the entire nation; Hawaii will receive a base line and an update every three years; Alaska will receive a base line and an update every five years.

c. 50 percent mandatory cost share 1-foot resolution imagery, updated every three years, for all states and Hawaii.

d. 50 percent mandatory cost share 1-foot resolution imagery, updated every 3 years, for all counties in Alaska with a population center greater than 25 people per square mile.

e. 50 percent mandatory cost share to agencies to acquire 6-inch imagery data to city areas that have a population greater than 50,000 or a population density of 1,000 people per square mile.

4. IFTN Option 4[189]

a. Proposed cost: estimated $1.55 billion for ten years to aerial and satellite imagery provider support.

b. 100 percent federally funded base line and annual update of 1-meter imagery for the entire nation; Hawaii will receive a base line

[188] Ibid., 4–11

[189] Ibid., 4–14.

and an update every three years; Alaska will receive a base line and an update every five years.

c. 50 percent federally funded 1-foot resolution imagery, updated every three years, for all states and Hawaii.

d. 50 percent federally funded 1-foot resolution imagery, updated every three years, for all counties in Alaska with a population center greater than 25 people per square mile.

e. 50 percent federal matching funds will be available to agencies to acquire 6-inch imagery data to city areas that have a population greater than 50,000 or a population density of 1,000 people per square mile.

On July 2010 the National Geospatial-Intelligence Agency (NGA) published a presolicitation[190] to gather request for information (RFI) data from prospective of interested companies to support the IFTN program; however, as of February 11, 2013, the results of the RFI has not been publicly available.[191]

Another sign of waning funds and an area of potential concern for imagery support, particularly in the civilian government sector, is the lack of new earth imaging satellite programs being deployed, such as USGS, NOAA, and NASA. Taking into consideration specific satellite support, tasking, life spans, and proposed mission coverage, all of the programs will be lacking in earthbound coverage in comparison to optimum replacements.[192] To summarize, earth observation is on a slow but steady state of decline.[193] Multiple circumstances are to blame. These range from operational, scope changes and over consolidation of missions; however, the key element to all issues is a declining budget and the necessity to pick and choose prioritized missions as oppose to

[190] Federal Business Opportunity, "Imagery for the Nation, Solicitation Number: ACR-2010-01," July 15, 2010, Federal Business Opportunity, accessed July 17, 2013, https://www.fbo.gov/index?s=opportunity&mode=form&id=5686bd9200cb1729a7fcd44b.

[191] National States Geographic Information Council, *Imagery for the Nation*.

[192] National Research Council, *Earth Science and Applications from Space: A Midterm Assessment of NASA's Implementation of the Decadal Survey* (Washington, DC: National Academy Press, 2012), 45–48.

[193] Ibid.

making accommodation for all conceivable activities. Even with priorities potentially being met, perceived lesser yet equally important missions may be lost with no plans to fill the gaps.

Figure 13 depicts the future state of affairs of planned, funded, and unfunded missions, and associated equipment requirements, in comparison to optimistic scenarios that will provide the actual optimum coverage required. Items in blue are funded; unfunded items in pink are optimistic scenarios that will cover existing programs and provide overlap for multiple earth science programs. As the Figure 13 presents, there is a clear gap between satellite tasking and the available resources to accomplish them.

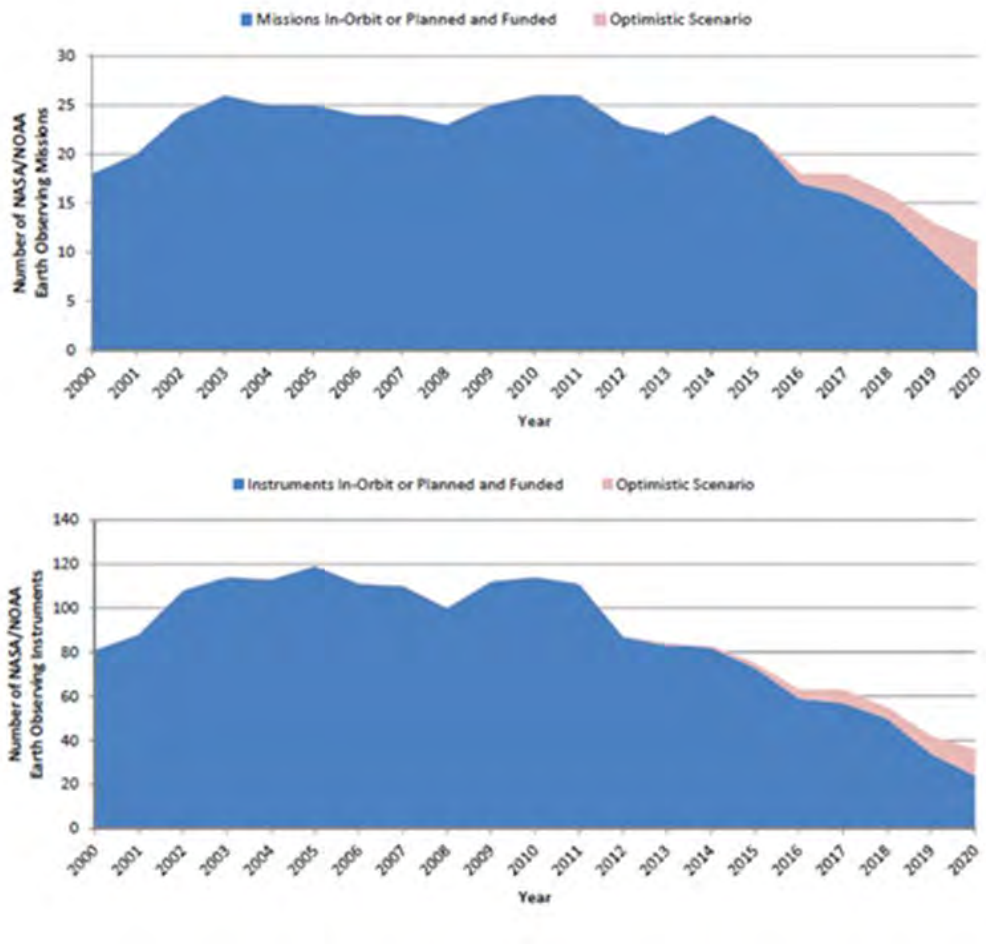

Figure 13. Future NASA/NOAA Missions Anticipated[194]

[194] National Research Council, *Earth Science and Applications from Space*, 46.

d. Policy Option 1: Ease to Implement

Multiple earth science programs have been managed through CAC programs. In addition, the CAC has made available to the public, via multiple websites, both imagery and mapping data that can be applied towards simple mapping for general purpose use as well as more sophisticated imagery and sensor data collection for earth science research. The National Map[195] viewer is a web based downloader that provides free mapping and imagery to the public. The products that are provided include U.S. topographical maps as well as historical charts. Data integrated into the viewer includes elevation, orthoimagery, hydrography, geographic names, boundaries, transportation, structures, and land cover. Another mapping site that the CAC provides is the GFP, a comprehensive collection of earth science experiments has collected more than 4000 one meter resolution images since 2008.[196] The data collected for these efforts are readily available to all users and is available through the CAC's GFP website.[197]

USGS, the CAC's parent agency, next to the Department of Defense, is one of the largest government providers of mapping and imagery data. The agency has the equipment to collect the information, the personnel to analyze, and the archiving capability to both store and distribute it. Though in its current package, minimal USGS data may be available for urban topography down to the half meter resolution range, the web-based infrastructure that the USGS maintains could conceivably house more detailed imagery and mapping information.

2. Policy Option 2: Reestablish the National Applications Office Evaluation

Despite past history and issues, could LE at all levels be better served if the National Application Office (NAO) was reestablished? An evaluation of Policy Option 2 in relationship to the grading criteria is presented.

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[195] The National Map Viewer website is accessible at http://nationalmap.gov/viewer.html.

[196] Molnia, "Monitoring Change as it Happens."

[197] The CAC Global Fiducials Program website is accessible through http://gfl.usgs.gov/.

a. Policy Option 2: Legislative Support

The NAO was established on the heels on 9/11. Although the CAC traditionally provided LE with disaster support satellite imagery, the George W. Bush administration proposed the establishment of an organization that would utilize the same national assets used in disaster assistance to support law enforcement.[198] As a result, the NAO was conceived to take over the LE portion within the CAC's mission. Thus in 2007, the NAO was launched and placed within the purview of DHS.[199] However, though significant coordination occurred between the CAC, the Department of Interior, and the Director of National Intelligence (DNI) in establishing the NAO, DHS did not adequately announce the new activity to either Congress or the American public.[200]

With regards to the new organization's establishment and initial funding, the DHS administration indicated that the "Intelligence and Appropriations oversight committees have been briefed and approved the reprogramming."[201] However, upon later query, it became more confusing between DHS and Congress from where the actual NAO appropriation derived. In a Congressional Research Service (CRS) report relating to the domestic use of satellite surveillance, a potential link indicated:[202]

> The programming in question probably involved a transfer of funds from an account under the control of the DNI to the DHS. Funding for the Office of the DNI is not part of Homeland Security appropriations legislation but is provided in intelligence appropriations included in defense appropriations legislation. It is possible that this funding was provided in classified annexes of defense legislation that was not brought to the attention of the House Homeland Security Committee or to the Homeland Security Subcommittee of the Appropriations Committee.

The NAO's initial funding immediately became questionable. Wherever the funding derived from, or if the actual communication was possibly in an errant

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198 Allen, "Why the Country Needs the National Application Office."

199 Department of Homeland Security, "Fact Sheet: National Applications Office," August 15, 2007, National Security Archive, accessed October 15, 2012, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB229/43.pdf.

200 Best and Elsea, *Satellite Surveillance: Domestic Issues*, 7.

201 Department of Homeland Security. "Fact Sheet: National Applications Office."

202 Best and Elsea, *Satellite Surveillance: Domestic Issues*, 7.

classified annex, it was apparent that that the House Committee on Homeland Security had not formally approved the action.[203] Though it seem there was a significant amount of discussion between key agencies with regards to the NAO's mission, function, and funding stream, key activities were left out, in particular, the House Homeland Security Committee and the Homeland Security Subcommittee of the Appropriations Committee.[204] From the very beginning, from a congressional perspective, the NAO was doomed to fail. To further add to its turbulent beginnings, the NAO management failed to establish a workable standard operating procedure on how specific requests would be routed, verified for legal compliance, managed, and disseminated.[205]

For two years, NAO had direct access to satellite operations and analysis to provide natural disaster and law enforcement support, an extension of what the CAC was already doing. At the end of the day, the NAO was perceived as a redundant mission. On June 23, 2009, DHS Secretary Napolitano shut the office down.[206] From a legislative standpoint, the NAO's failure was the result of poor planning on program development from the very start.

b. Policy Option 2: Legal Issues

Unlike the CAC, whose collection missions consisted of primarily scientific data gathering (an activity that does not inherently garner significant legal oversight), the NAO was the complete opposite. Despite that the activity established a mechanism to ensure legal oversight with regards to constitutional, privacy, and civil liberty legal tenets, it was later determined by the Government Accounting Office (GAO) that the NAO had significant shortcomings. Key findings that GAO determined included:[207]

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[203] Ibid.

[204] Jeffrey T. Richelson,"The Office That Never Was: The Failed Creation of the National Applications Office," *International Journal of Intelligence and CounterIntelligence* (2010): 79–81.

[205] *Turning Spy Satellites On The Homeland*, 56–57.

[206] Department of Homeland Security, "Secretary Napolitano Announces Decision."

[207] GOA, *National Applications Office Certification Review.*

1. DHS in principle established a mechanism to ensure legal compliance; however they did not resolve application procedures with regards to LE request for imagery collection.
2. DHS set up a system of determining legal review of satellite information request, but did not have a data management system in place.
3. Though later rectified, DHS initially failed to announce establishment of the NAO to the public in accordance to the Privacy Act of 1974.[208]

The NAO set up a system to ensure the protection of privacy and civil liberties, as well as PCA, EO 12333 and, albeit late, the Privacy Act of 1974 compliance. In addition, DHS maintained an internal oversight activity that included the DHS Inspector General, DHS Chief Privacy Officer, and the DHS Officer for Civil Rights and Civil Liberties. The activity also was established with external oversight from the Civil Protection Officer for the Office for the Office of the Director of National Intelligence.[209]

Though working within the confines of the law, the principle shortfall that the NAO had was a lack of having unconditional legal and procedural details established on an issue so sensitive from the very start; this should have been the very first step of establishing the organization. With the mass legal scrutiny that was drawn from multiple vectors, including privacy and civil rights organizations, Congress, and the general public as a whole, the likelihood of even the slightest notion of reactivating the NAO succeeding is remote.

c. Policy Option 2: Projected Cost

Due to the classified nature of the NAO budget, minimal, if any, cost information is available on the base program, let alone the management of the office operation.[210] A source of startup funding, though not specific, was likely derived from a

[208] The Privacy Act of 1974 requires all agencies to disclose the existence of a personal information data collection systems; this information is typically published in the *Federal Register*.

[209] Department of Homeland Security, "Fact Sheet: National Applications Office."

[210] Associated Press, "Homeland Secretary to Kill Domestic Sateliite Program Begun by Bush Administration," June 22, 2009, accessed August 21, 2013, http://peteking.house.gov/media-center/in-the-news/associated-press-homeland-secretary-to-kill-domestic-satellite-program.

congressional $634 billion partial funding budget line within the DNI to support the establishment of the NAO.[211]

Lacking even basic cost data regarding the program's original budget, the best that can be done is to base an NAO restart budget comparable to existing programs that maintain a similar mission of facilitating imagery satellite request from outside activities. Traditional activities within the military, IC, NASA, USGS, and NOAA that both own and operate satellite programs cannot provide an optimum budgetary starting point for a similar activity within DHS. The reason being was the NAO program layout was to be a clearing house for LE requests only; LE is neither an owner nor operator of space borne systems. DHS was not going to be responsible for the research, manufacturing, launching, ground based operations, or the multitude of other tasks associated with managing such equipment.

The closest activity that is somewhat comparable to the original tasks of the NAO as a facilitator for external LE request and can provide an inference of program details is the organization mentioned in Policy Option 1 of this thesis, the CAC. Though not an owner or operator of USGS satellites let alone national assets, the CAC operated as a clearing house to both the scientific and, when it pertained to disaster support, LE community. In Policy Option 1, two budgetary numbers were mentioned: 1) the IFTN proposal, which entailed a 10-year program ranging from $1.38 billion to $1.73 billion, and 2) the 2010 to 2012 budget of approximately $2 million per year to operate the office, facilitate the committee, and maintain the basic mission. As previously mentioned, the IFTN RFI has yet to be considered and a reestablished NAO would likely require a greater office budget. The CAC, with its existing budget, already maintains an established relationship and infrastructure with military and IC providers. In contrast, a new NAO would necessitate establishing relationships with the same activities from scratch.

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[211] Siobahn Gorman, "Satellite-Surveillance Program to Begin Despite Privacy Concerns," *The Wall Street Journal*, October 1, 2008, accessed June 15, 2013, http://online.wsj.com/article/SB122282336428992785.html?mod=fox_australian.

d. Policy Option 2: Ease to Implement

During one of the first discussions conducted by the House of Representatives, Committee on Homeland Security on September 6, 2007, a key dissenter from a list of many, included Barry Steinhardt, Director of Technology and Liberty Programs for the American Civil Liberties union (ACLU). Though Mr. Steinhardt did not recommend shutting down the NAO on the grounds of civil liberty and privacy concerns, he did ask the committee to think about the organization and the public concerns. Recommendations he presented included:[212]

1. a suspension on the on all NAO activity until Congress is satisfied that all its raised concerns during the hearing have been answered
2. that the suspension will not be lifted until Congress says so
3. that Congress should not rescind this suspension until it is confident that legal checks and balances are in place, as well as clear rules regarding the NAO's operation
4. that the Chief Privacy Officer of the Department of Homeland Security becomes an independent activity

The NAO maintained an office within DHS and a rudimentary request and collection process, albeit by no mean complete; however, unlike the CAC, the organization lacked a true infrastructure to support imagery data management. The circumstances are obvious—the organization simply was not around long enough to develop, and what little time it had in the primacy of its operation was spent managing a myriad of administrative issues that should have been in place before the office opened.[213] The lack of an adequate office infrastructure to coordinate task from the military, the IC, and the LE community was an obstacle that if given resources and time could have conceivably been fixed. However, the inability to assuage the public of legal scrutiny and the failure to eliminate the "big brother" label all but killed any future reimplementation.

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[212] *Turning Spy Satellites On The Homeland*, 41–42.

[213] Richelson,"The Office That Never Was," 65–118.

3. Policy Option 3: Make Greater use of Commercial Providers Evaluation

Would LE be better off acquiring its imagery data requirements themselves as oppose to relying of federal sources? An evaluation of Policy Option 3 in relationship to the grading criteria is offered.

a. Policy Option 3: Legislative Support

With federal resources dwindling resulting in waning support for all programs, Congress as always is tasked to investigate programs traditionally funded, identify legitimate needs, prioritize, and eventually reduce or cut resources all together.

As previously mentioned, the CAC itself had significant resources removed to a point that, with the exception of providing disaster management imagery, local LE would be cut off from all other support.

Since post 9-11, through multiple grant programs, the federal government has provided funding to both state and local police jurisdictions into the billions of dollars; however, those resources are dwindling. Similar to pre 9-11, though the federal government will continue support in local LE indirectly, the direct support in local operations will be significantly reduced; funding and managing departments at the lowest level is returning.

Like every conceivable service that a local police department will incur, the notion of managing its own GIS activity, including imagery collection and analysis is not foreign. The availability of both for cost, as well as free, imagery collection services is very apparent and provides an obvious benefit in lieu of an expensive government program. Legislatures and the citizenry will welcome the cost reduction.

b. Policy Option 3: Legal Issues

The use of any imagery satellite capability, commercial included, will always warrant consideration of existing laws, especially when it pertains to privacy or

civil liberties. Ensuring the compliance of all constitutional tenets will remain the same no matter who the owner or operator is.

Key issues that will need consideration are the use of imagery at cost versus free. Many for free services are more than adequate for establishing an awareness of the community served. In addition, they provide an extra data set for emergency action plans. However, a key element that requires thought with regards to using open source data is its potential admissibility in a court of law. Unlike the data options presented by more formal or for cost services, free data is exactly that—material though useful, but likely lacking specific collection details with regard collection time, resolution, system type used, altitude, original collection resolution, and a host of other issues that can be argued in a court of law.

Free or not, one key benefit, if not the principle one of all, is the collection or use of imagery from commercial owned and operated systems, not under the purview of either the military or IC, and its exemption from PCA, EO 12333, and a host of other federal restrictions.[214]

c. Policy Option 3: Projected Cost

Government and industry are ready suppliers of imagery both free and at cost. In comparison to the past use of aerial surveillance, the cost associated with collecting satellite imagery within a jurisdiction is significantly cheaper. Depending on an agency budget and the specific imagery required there are multiple sources where data can be collected. Shown in Figure 14, Google Earth is a free imagery collection service and GIS package that typically updates its imagery from one to three years,[215] a resource more than adequate for a common user. If current or greater sensor data is required, private users can make use of for-cost satellite providers. A sample of for-cost service is presented in Figure 15.

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[214] Korody, *Satellite Surveillance Within U.S. Borders*, 1641.

[215] Google, "Google Earth Frequently Asked Question," last modified 2013, accessed August 22, 2013, https://support.google.com/earth/answer/187961?hl=en.

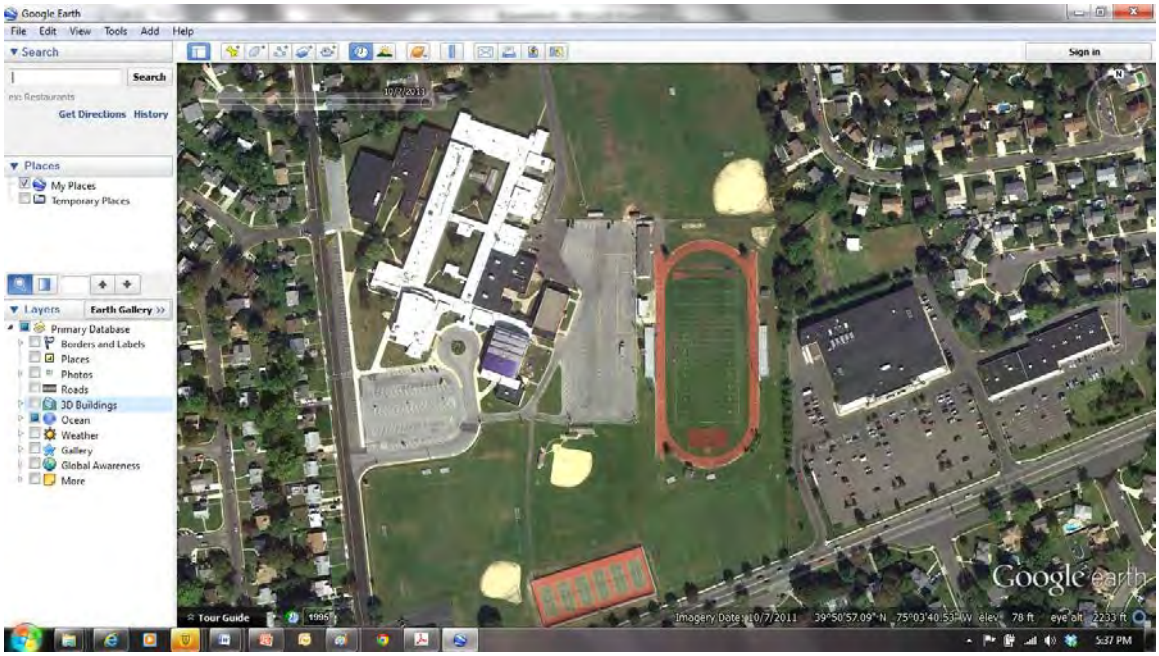

Figure 14. Google Earth[216]

[216] Google Earth, image, accessed August 14, 2013, http://www.google.com/earth/.

	IKONOS High-Resolution (1m) Satellite Imagery	Digital Globe High-Resolution (60cm) Satellite Imagery
		
Image Resolution (cell size in m)	1m	60cm (2ft)
Image Size or Minimum Order Size	Custom acquisition: 1) Minimum order is 100 km^2 for newly acquired imagery 2) Minimum order of 50 km^2 for archived images (Area ordered can be a polygon of any shape, but must have sides of no less than 5 km)	Custom acquisition: 1) Minimum order is 64 km^2 for newly acquired imagery 2) Minimum order of 24 km^2 for archived images
Available Spectral Bands	3 natural color 1 infrared 1 panchromatic Bands can be purchased in any combination.	3 natural color 1 infrared 1 panchromatic Bands can be purchased in any combination.
Applications	✍High-resolution mapping of individual facilities. ✍Siting of well pads/other facilities. ✍Audits of producing/refining facilities. ✍Emergency response and damage assessment. ✍Environmental monitoring of construction activities. ✍Hazard Identification: landslides, encroaching erosion, etc.	✍High-resolution mapping of individual facilities. ✍Siting of well pads/ other facilities. ✍Audits of producing/refining facilities. ✍Emergency response and damage assessment. ✍Environmental monitoring of construction activities. ✍Hazard Identification: landslides, encroaching erosion, etc.
Lead time[ii]	Archived: 10 days New: 30 -120 days[iii]	Archived: 14 days New: 30 - 120 days
Archived dates available	2000 to present	5/2002 to present
Cost for Archived Images	$7 - $24/ km^2 for natural color or infrared Minimum order = $350 - $1,200	$23/ km^2 for natural color or infrared Minimum order = $552
Cost for New Images	$20 - 36/ km^2 for natural color or infrared Minimum order = $2,000 - $3,600	$23/ km^2 for natural color or infrared Minimum order = $1,500
Cost Notes	Price varies according to reprocessing desired[v] Price varies according to location in the world	Price varies according to reprocessing desired[v]

Figure 15. Sample Cost for Custom Imagery Request[217]

[217] Walsh Environmental Scientist and Engineers, "Comparison of Satellite Imagery Used for Environmental Projects," Walsh Environmental Services, last modified 2013, accessed May 2013, http://www.walshenv.com/files/satellite_imagery_comparison.pdf.

d. Policy Option 3: Ease to Implement

For this option, the police users would be setting up their imagery requirement direct with a commercial provider, in contrast to coordinating with the federal government whose own collection requirements may take precedence over local LE. Add to that, the level of scrutiny that comes with the use of national assets, working with a commercial provider will be easier and quicker.

Most prepared police activities likely maintain or have access to a rudimentary GIS capability within their department. With multiple services available from direct providers, the ease to implement an imagery capability beyond a basic mapping capability only requires a computer, internet access, and a credit card.[218]

D. POLICY OPTIONS ASSESSMENT

Through Bardach's eight steps,[219] an assessment can be conducted citing both pros and cons of all three options.

1. Policy Option 1 Assessment: Further Supplement the CAC to Support LE

That the CAC is a vital organization from a macro perspective is very apparent. Its principle aim is coordinating the use of national assets for the purpose of supporting scientific efforts. In addition, it is a key element in providing vital imagery for both natural and manmade disaster management support. The USGS National Map and GFP viewer are very useful tools with regards to collecting archived mapping and imagery data. However, from a micro perspective and with regards to supporting LE at the lowest level, its support is inherently minimal.

[218] Google Earth Pro a higher fidelity version of Google Earth is offered for $399 annually, available http://www.google.com/intl/en/enterprise/mapsearth/products/earthpro.html?utm_source=google&utm_medium=cpc&utm_name=AMER-GEO-US-earthpro&gclid=CIK4kYrawboCFUyd4AodzlwAiw.

[219] Bardach, *A Practical Guide for Policy Analysis*.

A. From a legislative support perspective

1. the CAC provides a vital conduit for multiple users to have access to national assets
2. maximizing program cross pollination, by using national assets, eliminates the need to add more like-programs and systems thus reduces redundancies
3. since 2010, the CAC budget has been dwindling
4. though very helpful with supporting environment initiatives and disaster management, minimal to no direct support for criminal investigation is provided

Assessment: Neutral

B. From a legal issues perspective

1. the CAC does not engage in LE criminal investigation support
2. though the CAC must conform to all privacy and civil right laws, its principle mission of scientific collection, as opposed to direct LE support, does not garner significant legal scrutiny
3. the CAC still has to operate the program within all tenets of law especially when utilizing national assets: 1) Constitutional, 2) Executive Order 12333, and 3) PCA

Assessment: Neutral

C. From a cost perspective

1. the CAC budget has been waning into the negative numbers
2. departing personnel within the CAC are not being replaced
3. future government satellite launches for earth monitoring are on the downswing
4. a 2007 USGS and USDA feasibility study on establishing a comprehensive *Imagery for the Nation* Program[220] had a price tag in the vicinity of $1.38 to $1.73 billion to establish and maintain for 10 years

[220] National States Geographic Information Council, *Imagery for the Nation*.

Assessment: Negative

D. From an Ease to implement perspective

1. the CAC, through its parent agency, maintains both an imagery satellite operations, collections, and archiving apparatus
2. the CAC works closely with both military and IC activities, as well as their respective support apparatus
3. maintaining both the National Map and GFP data base provides a public access mechanism for the public and LE to acquire mapping and imagery data
4. a web-based infrastructure is in place to add more services if necessary

Assessment: Positive

2. Policy Option 2 Assessment: Reestablish the National Applications Office

Though established with positive intensions in a post 9-11 environment to support LE, the NAO failed to take into consideration several programmatic elements early into its development. Despite the NAO being established with safeguards with regards to privacy, civil rights, and PCA concerns, it was apparent that the oversight mechanism established did not assuage the citizenry and that significant confidence was lacking as to its true purpose.

A. From a legislative perspective:

1. DHS failed to formally inform the public of the NAO's establishment
2. DHS failed to formally inform Congress of the NAO's establishment
3. though classified, it was hard to ascertain where the initial NAO funding came from
4. there was a complete breakdown of communications between the NAO, key committees of Congress and Congress as a whole

5. though the office was in operation, the NAO lacked key operating procedures with regards to the management of working both internally and externally, in particular facilitating LE request
6. even with internal and external oversight, the NAO could not convince Congress of its ability to manage the operation in complete compliance of privacy, civil liberty, and PCA laws
7. a program established by one administration could not garner the support of an incoming administration

Assessment: Negative

B. From a legal perspective

1. on paper the NAO followed all the tenets of 1) constitutional, 2) statutory authorities and restrictions, and 3) executive branch authorities; however, it could not garner the public confidence that the activity would be conducted in a consistent legal manner
2. laws relating to any government surveillance activity is extremely complex
3. a mechanism was never put in place regarding LE use; minimal if no information was presented on how this would be accomplished
4. the level of legal complexity increased because of PCA and EO 12333 compliance concerns

Assessment: Negative

C. From a cost perspective

1. minimal cost data was presented for the startup of the NAO, the actual initial funding may have been part of a $634 billion DNI budget; however, no organizational specifics were provided
2. the closest government cost estimate for facilitating an LE-like satellite imagery and mapping program was the USGS and USDA Imagery For The Nation proposal, which had a price tag in the

vicinity of $1.38 to $1.73 billion to establish and maintain for 10 years[221]

Assessment Negative

D. From an ease to implement perspective

1. the NAO was only a facilitation activity
2. according to the literature available, the NAO had a minimal analysis capability
3. the NAO had a minimal mapping and imagery distribution capability
4. the NAO had a minimal infrastructure in the short time it was in operation
5. if reestablishment was considered, the activity would be starting with no existing capability in place

Assessment: Negative

3. Policy Option Three Assessment: Make Greater use of Commercial Assets

Access to commercial satellite imagery is available to the general public through many vectors, with internet providers being the most prevalent. Most services are free; however, if an activity requires a greater sensor capability, up to date information, or even a dedicated flyby into a specific area, these can be provided at cost.

A. From a legislative perspective:

1. the federal legislative process would likely not be involved with LE at the local level
2. minimal local legislative support would be required to support an in-house GIS program; the vast amount of imagery is either free or at minimal cost

Assessment: Positive

[221] As presented in Policy Option1.

B. From a legal perspective:

1. LE will still need to conform to privacy, civil rights, and constitutional laws
2. local LE using commercial imagery, at the lowest jurisdictional level, though garnering legal scrutiny will not draw as much in comparison to imagery collection at the federal level
3. the use of commercial imagery will negate the necessity to comply with the PCA or EO 12333

Assessment: Positive

C. From a cost perspective:

1. most commercial imagery is free, or at minimal cost, via the internet

Assessment: Positive

D. From an ease to implement perspective:

1. all that is needed is internet access
2. an account will be necessary for advanced or for-cost services

Assessment: Positive

E. POLICY OPTIONS ANALYSIS SUMMARY AND CONCLUSION

The ability to acquire any surveillance data provides a building block to a potential quick alert operation. Vital information to be fed into an action plan, and if properly administered and managed an evidentiary tool to be used in a court of law. Satellite imagery is a key component that can fill several of these LE requirements and more when left to creative users. Dating back to the notional concept of integrating it into disaster management plans as far back as the 1960s, its utility emphasizes its emerging practicality, even when the science was very young.

The purpose of this thesis is to explore the feasibility of LE gaining more access to national asset imagery or a suitable alternative. As a way to understand programs that facilitated civilian efforts, two federally managed activities were explored: the CAC and the now defunct NAO. As an alternative to the two government-based activities, a third

option was explored in the form of commercial providers. All three approaches to satellite imagery collection for LE purposes have clear advantages and disadvantages; some more than the other.

Table 1 presents a graphical summary of each policy option in comparison to the policy option grading criteria metrics. During the policy analysis assessment each of the four policy option grading criterion was either assigned a rating of positive, which represents a grade of 3, a rating of neutral, which represents a grade of 2, or a rating of negative, which represents a grade of 1. To present an example, under the grading criteria of legislative support, reestablishing the NAO would be the least effective approach with a grade of 1.Conversly, making greater use of commercial providers in the same grading criteria would be the most effective approach with a grade of 3.

Policy Option	**Legislative Support**	**Legal Issues**	**Projected Cost**	**Ease to Implement**
Option 1: Further supplement the CAC	Neutral 2	Neutral 2	Negative 1	Positive 3
Option 2: Reestablish the NAO	Negative 1	Negative 1	Negative 1	Negative 1
Option 3: Make greater use of commercial providers	Positive 3	Positive 3	Positive 3	Positive 3

Table 1. Policy Options Grading Criteria Summary

Table 2 presents a graphical summary of the total grades of all the policy options in relationship to grading criteria as a whole. As shown, reestablishing the NAO had the lowest grade while making greater use of commercial providers had the highest grade.

Policy Option	Total Grade
Option 1: Further supplement the CAC	8
Option 2: Reestablish the NAO	4
Option 3: Make greater use of commercial providers	12

Table 2. Policy Options Total Grade Summary

The founders of the NAO, which was designed to support LE at the micro and local level in criminal investigation, failed to take into considerations key elements during its establishment. This lack of detail and overconfidence of acceptance drew negative scrutiny from many sectors of American society. Though the activity could have been a vital asset, the organization could not escape the veil of distrust, and as far as the citizenry was concerned, this was a nontransparent tactic to infringe upon individual privacy. The organization lost its chance to instill even the most remote level of public confidence from the very beginning. As the assessment showed, there were no scores above 1; even in the best of circumstances, or the worst in the form of a national emergency, a semblance of an NAO-like activity at the federal level would likely never be considered for establishment. For purposes of this assessment, Policy Option 2: Reestablish the NAO, would be the least optimum approach to explore.

The CAC continues to maintain a vital program of supplying the science community with valuable imagery collected from national assets. The dual use of utilizing national assets emphasizes the fact that a level of facilitation between the military, intelligence, and civilian community does work, especially in the arena of disaster preparation and remediation support. Policy Option 1 graded high on ease to implement. The resources that the USGS and CAC provide during emergencies are well documented, though the members of the public may not know exactly how imagery is used in such events, they do know that this data at the end of the day saves lives and property. Because the organization maintains a large repository of both mapping and

imagery data and makes them readily available to the public through the Global Fiducials Program and the USGS National Map Downloader and Viewer, it is apparent that a web-based infrastructure is available. Therefore, the ease of implementing additional resources into an existing system would be less complex than an activity starting from anew. However, where the CAC scored low, as in most programs, was the likely cost to upgrade an existing system and populate it with current imagery data on a regular basis. The National States Geographic Information Council's, Imagery For The Nation proposal to the USDA and USGS was an extremely comprehensive program that was intended and designed for multiple users, in particular LE; however, the over one billion dollar cost for the effort likely exceeded available federal funding. Option 1: Further supplement the CAC, though it has benefits, was not the best approach assessed.

The best policy option presented was the least complex. Though there will always be an inherent distrust to any surveillance program, no matter its origin, in contrast to established government activities, LE would likely benefit far greater using commercial imagery providers. The relative ease of collecting material with minimal obstacles is a clear benefit of its use. Another obvious advantage, from a legal perspective, is its exemption from likely PCA and EO 12333 issues. Option 3: Make Greater use of Commercial Providers, had the overall best score as a policy approach to provide LE with imagery support.

VI. CONCLUSION AND LESSONS LEARNED

The necessity of a satellite surveillance mechanism is apparent. Whether it is used in emergency service management, LE operational development support, evidentiary data collection, or a host of other current and future uses, its efficacy is obvious. The incorporation of satellite imagery collection, if it is not already being conducted, is a vital segment of LE situational awareness. The design and purpose of this thesis was to answer the following research questions:

1. In coordination with the military and intelligence community, as well as other government agencies, is there a mechanism that can provide LE with greater access to national asset products, or a suitable alternative in the form of commercial providers?
2. Can this activity be conducted while adhering to and addressing constitutional law and likely privacy concerns?
3. Is there a mechanism or approach for assuaging the American public's to this type of surveillance; would a level of transparency work?

A. LE ACCESS TO IMAGERY RESOURCES

This thesis explored three policy options and ranked them against a specific grading criterion to draw a comparison in relationship to 1) likely legislative support, 2) key legal issues, 3) cost, and 4) ease to implement. The main purpose of this analysis, presented in Section 5, was to provide an assessment on the policy's viability relating to both program implementation and likely LE support.

1. The CAC and LE

As its stands, the CAC provides useful mapping and imagery via the USGS National Map Downloader and Viewer that can be read and incorporated into multiple GIS packages in addition to the proprietary software of the USGS. The GFP may be useful from the perspective of providing an additional source of data; however, the imagery delivered is geared more towards earth science studies and will likely provide

less relevant information than the National Map. The CAC has the in-house capability to provide greater support to LE in addition to the emergency services support they currently provide; however, the CAC is not in a position to provide direct assistance in criminal investigation. Imagery interpretation and analysis is a tasking that could likely provide significant subject matter expertise. Another potential flaw in the option is the inability for the USGS to update its mapping and imagery data; the National Map though useful, does not have an established mechanism to readily update data. The National States Geographic Information Council's, *Imagery for the Nation* proposal would have provided updated aerial and imagery data for 10 years, but it came with such a high price tag that was unattainable in an era of lean federal funding.

2. The NAO, LE, and Public Opinion

The NAO was a program full of good intensions that from the very start would likely never deliver to its principle customer: LE at the micro level. The fact that the NAO even got a start and existed, even for a short time, paints a picture of overconfidence in a program that was somewhat infallible from a legislative and public point of view.

From the very beginning, the office did a poor job of offering any program transparency; it took the media and congressional hearings to actually shed light on much of the activities existence. While there may be a certain acceptance to corporate intrusion into individual privacy, it is unfortunately the cost or circumstance in conducting any form of business. It does not hold true when the government is the monitor, surreptitious or not. Though most Americans can understand the utility of some surveillance programs, there is a justified distrust of the organization conducting the activity, the legality of the collection effort, and how the material is going to be used. Similar between the United States and other countries, both are quite content when the surveillance caught violator is an institution; as far as both are concerned, groups that push the envelope of established laws for the pure purpose of profit, deserve to be caught and fined to the maximum extent. However, there is an apparent difference when the target is an individual as opposed to a group. From an American perspective, even basic

surveillance monitoring of an individual is still perceived as extremely questionable because of civil liberty and privacy concerns. Passive, active, or blanket shadowing against one's privacy is simply not accepted by most Americans, whether it is justified or not; no matter the motive or purpose most will question its intention and overall justification.

3. Commercial Providers

Though the NAO and CAC presented a somewhat seal of government acceptance and access to the best imagery systems available, as it relates to both legal scrutiny, being exempt from PCA and EO 12333, and having ready access, commercial providers are the best option for LE. .

The public is going to always question the intension and purpose of any surveillance program. When the discussion is presented to the public with regards to such activity, at best the response is either lukewarm to completely negative; the trepidation is justified. Most individuals will deal with a CCTV in a public area; the camera is in plain sight and the only real angst may entail where their image eventually ends up and its future use. However, when using a tool that is out of the public eye, for example signals or satellite collection, the specter of government intrusion grows exponentially.

As of today, police activities do not have the ability to call up an imagery satellite, like a CCTV, and begin to collect real-time data on a potential criminal.[222] At the very minimum, what local jurisdiction has are the same mapping and imagery web services that the general public has access to or better. In addition to finding building code violators,[223] local LE will likely use these tools to prepare emergency plans for high profile activities within its jurisdictions. These facilities would include schools, public buildings, populated venues, and other areas of interest. As LE technology and capabilities improve, this will likely change to provide a better incident real-time picture.

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[222] This will likely change when more police activities acquire their own UAS capability.

[223] Eric Jaffe, "Code Enforcement Goes High-Tech, *The Atlantic Cities*, March 7, 2013, accessed August 21, 2013, http://www.theatlanticcities.com/technology/2013/03/code-enforcement-goes-high-tech/4899/.

The local citizenry will always be untrusting of a faceless monitoring activity; this is not to say that the same public maintains an unconditional non-acceptance across the board. However, the public though skeptical of any surveillance apparatus no matter who is collecting or using it, may gain a level of acceptance if LE is transparent on the potential use, benefits to the community, and success.

B. ADHERENCE TO CONSTITUTIONAL LAW

The Fourth Amendment is the cornerstone of all laws relating to individual privacy. The edict as it was originally prepared is an inherently noncomplex legal tenet made up of 54 words that talks about the legal conduct of searches, seizures, and the issuance of lawful warrants; it does not contain one word on "privacy" or "civil rights." Since the Fourth's ratification,[224] the amendment has been challenged in a conventional sense and modified, or retooled, to take into consideration realistic expectations of privacy as well as advancements in available technology. LE activities can be conducted well within the constitutional guidelines in the twenty first century; the Fourth gets retooled, as a result of judicial decision, in parallel to the law and time.

1. Retooling the Fourth Amendment

Section 4 of this thesis discussed Olmstead v. United States where the use of advanced technology, in this case wiretapping, was used against Roy Olmstead and challenged. In 1928, the courts determined that since the investigators did not remove any "tangible material effects" or conduct in any "physical invasion" that a search did not occur under the Fourth Amendment; Olmstead lost his case.

Almost 40 years later in Katz v. United States, though the evidentiary collection method was the same as Olmstead, the courts ruled differently. When Charles Katz was conducting an illegal betting operation in an enclosed phone booth, that happened to be wiretapped, he contended that his individual privacy was an extension of Fourth Amendment protection. In 1967, the courts determined, in contrast to the 1928

[224] The Fourth Amendment, which is part of the Bill of Rights, was ratified on December 15, 1791.

interpretation, that an individual's privacy played a role in a Fourth Amendment search; they determined that the law was applicable to individuals and not particular places. Katz won his case.

When comparing Olmstead and Katz, in 1928 Olmstead the line was drawn at the "place," in 1967, the Katz case ruling redrew the line to the "person." With this new, or reinterpreted, metric, the courts established a set privacy standards that know test Fourth Amendment compliance where 1) the person must have an expectation of privacy, and 2) the expectation must be reasonable.

2. Expectation to Reasonable Privacy and the Public Place

More often than not, an individual's expectation to reasonable privacy is at odds with his or her specific location. If Charles Katz was conducting his enterprise on a crowded subway, with his fellow passenger listening in, would he have been accorded that same verdict? The same can be said with regards to the sliding scale of privacy; the shifting of a surveillance covey to determine a search from a non-search as it relates to a constitutional perspective.

The use of conducting a search within an environment where the public has access can radically change the definition of a search.[225] For example, California v. Ciraolo, Dow Chemical Corporation v. United States, and Florida v. Riley were all cases where the sliding scale of privacy was apparent with regards to the definition of a search. If the principle evidence for Dante Ciraolo, Dow Chemical, or Michael Riley was collected at ground level, behind a fence line, and without a warrant, the ruling of each of their cases would have been in favor of them because of constitutional noncompliance. What made the difference in all three cases was the ability to manage the collection effort from nonpublic to a public area. In these cases, the collection area was shifted from the ground, behind a fence, to an area that the common citizen has free access—public airspace where aerial surveillance was properly conducted and admissible in the courts.

[225] Most police activities would likely have a warrant already in place.

A question that is being presented in legal proceedings today regarding public imagery is: if the public has access to it, is it fair game to not call it a search? If the end user knows the imagery information is historical and can only be useful in producing evidential generalities, as long as it is being used in the framework of an open or public space environment, can this be construed as a virtual public airspace open to all and constitutionally above board?

C. ASSUAGING THE PUBLIC

Often it is interpreted in many circles that "transparency" is an ugly word; any release seems to come with great resistance from the owner. Often, when information is declassified it is either because the data itself is so old to matter or a leak from a source other than the principle processor occurred. One area where the system fails in is perpetuating a continuous culture of secrecy; basically any surveillance product generated, no matter how benign, is immediately slapped with classified stamp. In the public's eye, it is just hard to trust an institution that relentlessly and unconditionally keeps secrets.

1. Transparency as a Solution

Lack of transparency, in of itself, may be necessary to avoid compromising an investigation or surveillance trade craft. However, the blanket exclusion of providing even a token explanation of the material collected, its justification, purpose, and policy draws a societal mistrust of the system as a whole. And that distrust increases when an additional unknown program is discovered rather than preemptively discussed up front.

Progressive LE activities makes a point to show how criminals are caught in the neighborhood, often by exhibiting surveillance material to the members of the community which they are policing; this is presented by the media on a daily basis for the viewer to see and often to indirectly assist in the investigation. From one perspective, LE is showing that its systems are working by putting known criminals in jail and the second is forewarning potential wrongdoers that they are being watched and will be the next individual arrested. This is an improvised method of frontloading legal compliance by

introducing a healthy fear of getting caught. On the other hand, if the local citizenry feels that individual privacy is being unduly infringed upon, a local police chief is often extremely accessible.

D. LEARNING FROM OTHERS TO EXPLORE AND IMPLEMENT A NOTIONAL APPROACH

Local LE will manage its GIS requirements commensurate to the requirements of individual jurisdictions. It not going to wait for a national mandate—this is a good approach. However, should further examination be conducted on how other country's LE activities conduct satellite surveillance as an investigative tool? Though the interpretation and sensitivity to individual privacy may be vast, can a common ground be found?

When coupling the understanding of privacy from a domestic to an international standpoint, more often than not the United States is a minority when it comes to being perceived as hyper-sensitive to privacy. In comparing a similar international equal, Australia is in a somewhat different situation, where, according to the Australian Law Reform Commission, "the recognition of a general right to privacy warranting legal protection is a relatively modern phenomenon."[226] Though they follow the tenets of both the Universal Declaration of Human Rights and the International Civil Covenant of Political Rights and European Convention of Human Rights, in comparison to United States law, privacy laws are inherently new to Australian jurisprudence.

Minimal case studies are available regarding the use of imagery satellites against felony-based crimes, but that is not to say is does not occur. However, a classic study of where this form of advanced surveillance occurs, at the individual level, is in the arena of environmental compliance, principally the law breaking Australian farmer or property owner.

Though still Australia somewhat learning the specifics of privacy laws, in comparison to the United States as of 2010, 53 trials have been conducted within the

[226] Australian Law Reform Commission, *For Your Information: Australian Privacy Law and Practice* (ALRC Report 108) (Sydney: Australian Law Reform Commission, 2008), section 1.33.

Australian court system where satellite imagery was key evidence.[227] In Australia, if satellite photo interpretation has determined that unregulated land clearing, against an individual, has or is occurring, direct legal action can be pursued; an activity with which the U.S. legal system is inherently not acquainted.

Satellite imagery collection was initially used as an analysis tool to monitor landscape health as a means to establish and bolster policy decisions on land resource management; it was later determined that policy was often ignored.[228] The next option was to take this technology and integrate it into a surveillance monitoring methodology that could be readily integrated in a court of law.[229]

Despite the early hurdles, Australian magistrates are grasping the technology, utility, and practicality of satellite imagery in their courts. The ability to see a picture objectively, followed up with witness testimony, enhances the integrity of court proceeding. However, as in every case of introducing new methods, especially in the legal system, prosecutors, technicians, and investigators had to learn how to break new ground using this type of data in a court of law on a regular basis. A key to success was the ability for all three groups to work together in properly establishing a chain of evidence[230] that could be legally introduced in a court of law.

Ironically, when Australian farmers were surveyed on the notion of their properties being monitored by satellite for ensuring environmental compliance, the majority were either neutral to highly in favor to such monitoring. The key to acceptance

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[227] Ray Purdy, *Satelllite Monitoring of Environmental Laws, Lessons to be Learnt from Australia* (London: Centre for Law and the Environment, Faculty of Laws, University College London Centre for Law and the Environment Research, 2010), 189–206.

[228] Robyn L. Bartel,"Satellite Imagery and Land Clearance Legislation: A Picture of Regulatory Efficacy?" *The Australian Journal of Natural Resources Law and Policy* 9, no 1, (2004): 1–31.

[229] Robyn L. Bartel and Joseph H. Leach,"Big Brother and the Law of the Land: The Role of Satellite Surveillance and GIS in the Regulation of Land Clearance," in *Proceedings of the Spacial Information Research Centre's 12th Colloquium* (SIRC2000), University of Otago, New Zealand, 2000, 267–277.

[230] The National Institute of Standards and Technology, Australian Standards and New Zealand Standards, or AS/NZS Standards, and the British Standards Institution provide guidance on digital imagery and its use in the legal system.

of the monitoring program was transparency, active communications with regulators, and having access to the imagery itself. [231]

E. WHAT WORKS

Key elements that are working in Australia's favor is 1) starting small, 2) concentrating its current effort towards environmental violators, and 3) making the surveillance program transparent. There exist, within the United States similar options that can be explored where lessons learned have been acquired. Recommendations would include:

1. Being realistic: With the exception of high profile natural and manmade disasters, the likelihood of supplemental funding or assistance from the federal government for imagery support for LE, outside what is already available, is unlikely. It will be up to the individual jurisdictions to set up their own capability.

2. Starting small: Establish an imagery database of the jurisdiction being managed. Make it a point to collect imagery on high profile activities and start generating notional emergency operations plans using that data and ensure that the plans are updated on a regular basis. Additionally, make certain the community knows this activity is being conducted to protect the citizenry.

3. Use in court: Unless data is extremely current and documented the best it can provide is a historical timeline; that is not to say that it cannot still be used as supplemental evidence. With regards to public acceptance in the courts, laws against the environment are a topic where the American citizenry can rally around; as a whole, pollution violators impact the community. The use of imagery against groups or individuals, who inherently are against the community, will establish a public acceptance to this form of evidence collection.

[231] Purdy, Satellite Monitoring of Environmental Laws, 119.

4. Establish legal guidelines: There are guidelines readily established for the introduction of digital photography in a court of law;[232] further extending those same guidelines, including satellite imagery, will be beneficial.

5. Establish and maintain talent: Establish and maintain a talent pool inside and outside of the organization that can manage, analyze, and ultimately present data in a court of law.

6. Commercial assets: Make greater use of commercial satellite providers to either supplement or replace government resources.

7. Transparency: Make the LE use of satellite imagery transparent.

8. Results: Openly show the results of imagery evidence and how it convicted the guilty party.

9. Publish: Make it a point to publish and share GIS capability and methodology with colleagues.

Satellite imagery has proven that it is an essential tool to many activities; the military planner, disaster managers, LE, and the common citizen. It is being used for a vast array of purposes. Aerial and UAS technology, as it relates to the law, is being written and perpetually updated. The evidence it produces for the courts is an obvious signal that the regular use of more advanced surveillance tools are on the horizon. Frontloading key considerations for the justified use and the public's sensitivity to privacy will make for a less turbulent satellite based collection program.

[232] National Institute of Justice, Uniteed States Department of Justice, *Forensic Examination of Digital Evidence: A Guide for Law Enforcement* (NCJ 199408) (Washington, DC: Department of Justice, 2004).

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